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ELECTRICAL WORLD AND ENGINEER.

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CONTENTS.

Editorial 827
What Electricity has Done for the Manhattan Elevated 830
Electrochemistry at the Mass. Institute of Technology 830
The Chateaugay Water Power in the North Country 831
Direct-Current Traction at 1200 Volts in France 832
Melting Sleet on a Third Rail. By W. A. DelMar 834
The Induction Coil Spark. By Alfred G. Dell 834
Calculation of the Apparent Inductance of Armature Coils—II. By C. C. Hawkins 835
The International Wireless Telegraph Conference 836
The Choice of Wattmeters. By Paul MacGahan 837
Transposition of Telephone Lines: Cross-Talk and Induction 838
Recent Electrochemical Developments 841
New Fessenden Wireless Telegraph Patents. By A. Frederick Collins 842
Trackless Trolley Experiments at Scranton, Pa. 842
New Telephone Patents 843
Meeting of Philadelphia Institute Chapter 844
The Chatel St. Denis-Palezieux Railway 845
A Riedler Steam Turbine 845
Power Transmission in Washington State 846
Current News and Notes 846
LETTERS TO THE EDITORS:
Hydraulic Units. By E. Adler 848
Barbed Wire for Lightning Protection. By W. C. McEntee 848
Digest of Current Electrical Literature 849
New Books 853
Electric Railway Commission for St. Louis Exposition 854
Dr. Hans Goldschmidt on Aluminothermics 854
A New Divided Tile for Underground Work 855
New Electric Lighting Specialties 855
A Small Domestic Lighting Plant on Long Island 856
DEPARTMENTS:
Commercial Intelligence 857
Financial Intelligence 857
General News 859
Trade Notes 863
Record of Electrical Patents 863

ELECTRICITY ON THE MANHATTAN.

For a great many years this journal advocated the adoption of electricity on the Manhattan elevated road, but Mr. Russell Sage and a few others like him pooh-poohed the idea with equal persistence. Now that electric traction prevails over the whole system, thanks to the vigorous policy of the present management, it is at once seen to have justified every word that was said in its favor. We give elsewhere the figures of the last annual balance sheet. They speak for themselves, but one or two points may be made. Up to the time of the change, the Manhattan system had not been able to earn 7 per cent. upon the old stock. Now that the stock has been increased by $7,200,000, the earnings equal about 10 per cent. upon the old and 8½ per cent. upon the new capital. The wages of the employees have been increased during the year, and the hours of work have been cut down. The growth is demonstrated by the totals of gross earnings for the last four years. Earnings were but $9,115,348 in 1900; in 1901, $9,620,564; in 1902, $11,067,746; 1903 the total was $12,651,977, but the operating expenses have been falling off in their percentage. In 1902 the percentage of expenses to earnings was 51.19. In 1903 it was only 42.02.

This is no unusual experience. It has, indeed, been common and recurrent ever since the trolley came in. It will be renewed and repeated every time a steam railroad management has sense enough to drop its locomotives and turn to electric motors. It is the best of bull arguments for the future of railroad properties, which, as they approach the limits of net earning capacity under the old régime, have magnificent new opportunities opened up before them in a field of transportation that has the Manhattan on one horizon and Zossen on the other.

TRACKLESS TROLLEYS.

During the past year or two the subject of trackless trolleys has been taken up in Europe and our pages have recorded experiments and results in France and Germany with electric vehicles of the automobile type, receiving their current from overhead wires. In this issue we illustrate some experiments which have lately been made with a fair showing of success by an American system at Scranton, Pa. This, so far as we are aware, exemplifies all that is being done in the United States in this direction at the present time, although there has been talk in the newspapers of proposed trials at Schenectady with one of the European systems. As to the future of such work, it is very easy to build up agreeable conjectures in regard to the number of lines which might be equipped along city thoroughfares and country roads, where tracks would not be permitted or where it would not pay to lay them. But there are many good things in electrical development which do not make the headway one would expect of them. Sometimes the hour is not ripe; sometimes the ultimate conditions are not altogether favorable; sometimes the public does not take kindly to the new departure, but for whatever reason it may be, the invention or idea whose merits can be argued with great plausibility is slow in taking hold. It may be somewhat this way with regard to the trackless trolley. It has been talked about for a good many years past, but to-day only two or three lines are running; and the reason why it lingers is not quite clear.

It is said that the trackless trolley takes twice as much current for the same passenger service as does a regular trolley line, but this

should not stand in the way of an extensive adoption of the system if there are places where it could be utilized to advantage. One hears a good deal about insuperable objections to trolley tracks, and the availability of these trackless systems, but it is not quite plain whether the public prejudice is against the track or against the overhead construction, or against both. In the long run, a great many of these objections disappear and the trolley goes in. As between trackless trolleys and regular storage battery automobiles, it would appear that the honors are at present easy, but regular automobile stages have not made anything like the inroads into the transportation business that the public has been led to expect.

The Police Telephone.

The utilization of the telephone in connection with police patrol work is not new, dating back as it does to the efforts and success of Mr. John P. Barrett, in Chicago, in the very early eighties. But the system just inaugurated in New York City and put into operation in the first police precinct is certainly a new departure and the beginning of a new régime. Just how far beyond Manhattan it may go no one could say at this period, but on the face of it there are sundry merits not easy to disregard, and the question interests telephone people all over the country. Under the contract with the New York Telephone Company the Police Department has called for over 660 police telephone stations, which will be employed in each of the 29 precincts in numbers varying between 20 and 30 per precinct. This obviously gives control of a wonderfully complete network of communication. It is also obvious that it is a radical departure from the old plan of buying outright at large cost a separate and independent police patrol system.

How far the new plan will be superior to the old remains to be proved. We understand that the telephones are in series groups of six, but that is an objectionable feature in technique that can readily be changed. The essentially novel feature is that all the work of installation, maintenance and operation, aside from the police operators at each precinct switchboard, is to be done by the telephone company by its own regular staff, so that the police force will not have to maintain its own construction, line and repair force to look after wires, batteries and other accessories. Under such conditions the work ought certainly to be well done.

It will be observed also that this is a variation upon the popular plan of municipal ownership and control. The plant involved is all private plant, and an annual rental is paid for its use. Just how far this plan could be carried in other departments we do not know; but on the face of it it has the appearance of a sensible, business-like arrangement, worthy of repetition.

The Choice of Wattmeters.

Mr. MacGahan's article on page 837 emphasizes the importance of an accurate knowledge of the properties of a registering watt-hour meter. It is pointed out that recent improvements in watt-hour meters have been of great commercial value to the central station. At first sight it would appear that in a distributing system a meter should, above all things, be accurate at full load. It is, of course, highly desirable that, at full load, a meter should record correctly. But when it is observed during how short a period a meter works at full load, and during how long a period it works at a comparatively small fraction of full load, it becomes evident that, above all things, a meter should be nearly accurate at light load.

A recording watt-hour meter may be accurate within a very satisfactory small limit when it is first installed, and then, as time goes on, fall away from grace. In such cases the error is nearly always attributable to increase of friction in the moving system. Very rarely does a meter in service get over-active in old age. Much more frequently is it overtaken by laziness and a low constant. When such is the case through friction, the error will be magnified at light loads, since at that time the ratio of frictional opposing torque to driving torque will be large. Consequently, the meter which has the largest driving torque per watt, or the largest full-load torque, will be the meter which is least likely to retard seriously at light load through undue mechanical friction.

When a station manager installs a motor in his plant, say for driving a hoist, he is supposed to know the starting torque of the motor, and to have ascertained its sufficiency for the load to be carried. Until recently he was not supposed to know the starting torque of the watt-hour meters installed on the premises of his customers. Now, however, he is supposed to be acquainted with the torque in gramme-centimetres of his meters at their minimum load, and to have satisfied himself that it will be sufficient, not only to overcome the greatest friction that is likely to occur in normal use, but also that it will be so much greater than the friction as to make the error small, on the lowest load the meter will have to work upon.

The American Association for the Advancement of Science

The most recent volume of the proceedings of the A. A. A. S. has just been issued. It weighs two pounds and contains 594 uncut pages. Why scientists should have to expend time in the process of cutting pages two at a time by hand in order to read the contents, when a machine can cut them all in less than a second at one stroke, is hard to comprehend. As a relic of barbarism in a society formed to advance science, such an unnecessary labor-creating device is distressing.

More than half of this heavy volume, or 312 pages, is devoted to an enumeration of the 3,596 members of the association, and other purely secretarial matter, of very trivial importance to the average reader. It would surely be more economical to keep the printed list of members, on demand, at the headquarters of the association, and spare the mails and bookshelves of the country this superfluous pound of dreary text. The gist of the publication comprises nine addresses made in nine of the ten sections, respectively. These are of much interest, and they extend over 140 pages, or less than one-quarter of the volume. Wasteful as the publication is, it is welcome and worthy on account of these nine papers.

There are two sections of the association, whose proceedings are of especial interest to ourselves and to our readers, namely, section B, on Physics, and section D, on Mechanical Science and Engineering. Fifty-five papers are stated to have been read in section B. Of these several appear from their titles to have interest for electrical engineers. Yet these papers are not published. A list of titles like headstones in a cemetery is all that marks the labors of each author. Fortunately, some of these papers have been rescued from oblivion by the charity of other printing presses. The Physical Society, for example, has printed some. But it is surely a grief and a shame to see so much index and so little literature in this volume with the scattered titles of murdered pages calling for more generous treatment. Such wholesale slaughter of scientific effort is more appropriate to a mediæval age. It can only be excused by the direst necessity. If these papers cannot be printed owing to want of funds, an organized effort should at least be made to have other associations rescue and print them. Nevertheless, the policy of the association has been to give out as little to the technical press as

possible, lest peradventure the dead should have more room and less company. It is earnestly to be desired that the association should do all in its power to give permanence to the papers committed to its trust. At least, if they cannot be printed, they should be collected and preserved in the archives, so that members can have subsequent access to them.

BRITISH ENGINEERING STANDARDS COMMITTEE.

The Engineering Standards Committee of Great Britain has recently issued a statement of the resolutions they have adopted concerning standard direct-current pressures, and also concerning alternating-current frequencies. In this country the American Institute of Electrical Engineers recommend the standard generator terminal voltages of 125, 250 and 550 volts, which, with 8 per cent. drop in transmission, represent 115 volts, 230 volts and 506 volts, at motor terminals, respectively. The British committee favor 110, 220, 440 and 500 volts at consumer's terminals. This is practically the same as American practice, with the additional pressure of 440 volts.

With us the standard street railroad pressure at the cars is 500 volts, while for private right-of-way railroads 600 volts is sometimes used. These are also the pressures recommended by the British committee. With us the frequencies of alternating current are 25, 40, 60 and 120 cycles per second, the frequency of 40 being relatively rare, and the frequency of 120 being on the decline. The British committee recommended 25 and 50 cycles per second. The essential difference, therefore, between the A. I. E. E. and British recommendations is that while we have 25 and 60 cycles per second, they have 25 and 50.

It is to be hoped that sooner or later there may be standard frequencies and standard pressures all over the world. This standardization of machinery naturally tends to aid industry and promote trade throughout the world. All are gainers by it. It is greatly to be desired that an International Electrical Congress should take the subject under consideration.

RATES FOR LIGHTING AND POWER.

Among the numerous good offices extended by the National Electric Light Association to its members, its recent report on the rates for lighting and power charged throughout the country is conspicuous. With the increased use of water power on the one hand and of underground distribution on the other, two opposing influences have been at work, the one tending to lower prices, the other to maintain them. Besides, the old contract system is rapidly disappearing, and is being replaced by the meter system with all sorts of ingenious modifications based on the nature of the service and operating to favor the large and steady consumer. The report before us gives fuller information as to the present customary charges than anything we have yet seen in the line of electric lighting statistics. Its most conspicuous feature is the evident tendency to favor the consumer by lower prices. The old basis of 20 cents per unit with small discounts, or approximately 1 cent per lamp-hour, is now seldom maintained, and when used at all is generally modified by discounts for prompt payment large enough to form a substantial reduction. Common prices are 15, 17 and 18 cents per unit, with rather liberal discounts. Many plants in the regions of cheap coal have come to even lower prices, as have water power plants generally, and the number of plants charging as low as 10 cents per unit is rather surprising. For power service 10 cents with large discounts is rarely exceeded, with many plants selling at 5, 6 and 8 cents, with ample discounts to the larger consumers. The lowest figure for power which we have noted is 1 cent per unit for consumers taking 300 hp or more, but sliding discounts bringing the price down to 2 or 3 cents per unit are common in case of water power plants or those in regions of cheap fuel. One cent per unit is a very low figure, necessarily the result of peculiarly favorable conditions.

In looking over the list of rates there is widespread evidence of a struggle to secure something better than a flat rate with sliding discounts. It is for the interest of most plants to favor the consumers who call for a large and steady load, and capacity charges loom up in the list under numerous forms. A few plants use the maximum demand system in some form, but more depend upon a fixed minimum monthly charge and service charges in one form or another. A device not uncommon in the West is an increased rate for residence lighting, although a few plants in situations where residence lighting must be cultivated grant it a specially low rate. On the whole, it is very clear that much remains to be done in the way of devising a simple and fair system to take account of the nature of the demand for energy. It is a subject which has provoked much controversy, most of it fruitless. After reading over the discussions of the matter one is forcibly reminded of Carlyle's characterization of metaphysics: "High air castles are cunningly built out of words, well laid, moreover, in good logic mortar; wherein, however, no knowledge comes to lodge." We are strongly under the impression that most of the systems proposed attempt too much. It is as if they attempted to lay out a standard line of shoes by means of a formula based on the average proportions of the human foot, instead of furnishing arbitrary sizes, each made in several widths. It would be interesting to determine the possibilities of a flat rate with customers rated according to the nature of the service in classes A, B, C, etc., each class carrying its own simple set of discounts. Of course, there would have to be occasional close decisions, but we doubt whether the total annual number of kicks would be out of the ordinary. Something of the kind was occasionally tried in the early days of motor service, but not in the systematic way that is needed to secure practical results. It may be possible to devise a system that can automatically take account of all contingencies; but it is likely to be complicated, and like other complicated things, to get out of order when subjected to trying conditions.

An interesting side light is thrown on this very valuable document by a recent consular letter giving the current rates for electric light and power in various continental cities. The lowest figure is that which will apply in Berlin after January 1 next—10 cents per unit for lighting, and for power purposes down to a minimum of 3½ cents per unit. This is a little lower on lights and a little higher on power than the prices in American cities of comparable size. In other continental cities the prices range about as they do here, but we think that the American plants are the more liberal to users of motors. In the smaller cities and towns we are disposed to the belief that American prices will range lower than the continental ones. Of course, we gain here in the average cost of fuel, although losing on the labor account; but altogether the American plants make a very liberal and business-like showing. We are glad to note that the next report of the National Electric Light Association upon this topic will contain the prices of fuel at the various points concerned, which will be a valuable addition to the other information. The cost of fuel is generally the main factor in the local conditions as to price, particularly in the smaller cities. When underground service has to be undertaken the situation changes and reductions in price become somewhat difficult. Hence, it is never fair to expect extremely low figures in the larger cities, unless under exceptionally favorable conditions.

What Electricity Has Done for the Manhattan Elevated.

The beneficial effects of the adoption of electricity in place of steam for traction are well shown in the annual report of the Manhattan Elevated Railway Company, of New York City, whose system is now known as the Manhattan Railway Division of the Interborough Rapid Transit Company. At the meeting the members of the old board, President Gould made these remarks: "Since the last annual meeting the electrical equipment of the company's lines has been completed and the expectations of the management have been fully realized, both as to increase in carrying capacity and economy of operation. On April 1, 1903, the lease of your company to the Interborough Rapid Transit Company took effect and possession of the property was delivered on that day to the lessee, which has since operated the railway. The statement of operations presented, therefore, relates in detail only to the six months ending March 31, 1903, and with respect to the last six months includes only the dividend rentals paid by the lessee."

The gross earnings of the company for the six months ended March 31, 1903, were $6,441,437; operating expenses, $2,819,764, and net earnings, $3,621,673. For the remaining six months of the fiscal year the report includes the $1,656,000 paid to the Manhattan Company by the Interborough Company in dividend rentals to make a grand total of $10,996,772 of surplus and income. Dividends paid to the Manhattan stockholders amounting to $3,894,000 are deducted, leaving the total surplus on September 30, 1903, $7,102,772, compared with a surplus on September 30, last year, of $6,372,418.

A combination of the report of the Manhattan Railway Company for the six months ended March 31 last, before it became a division of the Interborough Rapid Transit Company, with that for the six months ending September 30, shows that the gross earnings of the Manhattan Company for the year increased $1,584,231, and by a decrease of $115,921 in the operating expenses, the net earnings were increased $1,700,152. The balance, after the payment of interest and taxes, increased $1,397,736, and was brought up to $4,723,798. This is equal to 8.56 per cent. on the entire $55,200,000 capital stock of the company, and compares with a surplus in 1902 equal to 6.93 per cent. on the $48,000,000 stock at that time outstanding.

The report of the Manhattan Railway Division of the Interborough Company states that in the last six months 125,548,740 passengers were carried, as compared with 108,164,184 for the corresponding period last year, an increase of 17,384,556. Evidence as to the excellent results attained by the installation of electricity as the motive power is shown by the fact that the operating expenses of the company for the period mentioned were 42.02 per cent., as compared with 51.19 per cent. last year, when steam locomotives drew the trains.

The number of passengers carried in the last quarter was 59,443,304, as compared with 50,464,936 last year, and 66,105,436 in the quarter ended July 1 last. For the quarter ending July 1 last year 57,699,243 passengers were carried. Moreover, all these passengers have benefited greatly by the increase in speed of the trains and the lessened running time per trip.

Electrochemistry at the Mass. Institute of Technology.

According to an announcement in the *Technological Review*, published by the Massachusetts Institute of Technology, Boston, a new laboratory devoted exclusively to electrochemistry was opened at the beginning of the school year. This laboratory has been equipped to provide facilities for the professional work in the senior year of students electing the schedule of electrochemical studies offered as an independent option in Course VIII, and for graduate students desirous of taking up this line of work.

Instruction in electrochemistry has been given to students in physics since 1894, but the recent rapid development of the industrial applications of the science determined the department several years ago to extend the work and to lay out a schedule of studies directed particularly to this end. This course was officially announced by the Institute in the summer of 1900. Provision for somewhat similar work had already been made at the Polytechnikums at Zurich and Darmstadt, and more recently special electrochemical laboratories have been established at Karlsruhe, Aachen, Berlin and Manchester (England). In this country, too, distinct courses in electrochemical engineering and electrometallurgy are now offered at the University of Wisconsin and at Lehigh, respectively, while more or less specialized instruction in electrochemistry is offered at many of our more progressive technical schools and universities.

The course as laid out at the Institute aims to give a student a thorough grounding in the principles underlying electrochemical problems in general, and so much of electrical engineering as will enable him to deal with the various power problems which are likely to arise in connection with the installation of electrochemical plants. To this end the course provides for a thorough training in theoretical and applied electricity, these subjects forming the foundation for the professional work in electrochemistry, which extends throughout the fourth year. Instruction in organic chemistry, mineralogy, assaying and metallurgy, and in the elements of machines and engineering, is also given to as great an extent as practicable.

The work in electrochemistry proper consists of a thorough course of lectures on theoretical and applied electrochemistry, accompanied by extended laboratory work on electrochemical methods and measurements, and on technical processes carried out on a scale sufficiently large to give the student some just idea of the factors which determine their efficiency. To provide for this work, the new laboratory opened in October as a part of the Rogers Laboratory. It was not until this summer that the space vacated by the Electrical Engineering Laboratories made the equipment of this laboratory possible. The laboratory occupies the rooms formerly devoted to the Physico-chemical and Heat Measurements Laboratories in the basement of the Walker Building, these laboratories being now removed to more commodious quarters. It is 95 by 30 ft., and is divided into two distinct parts, one being devoted to electrochemical measurements and analysis, and the other fitted up for technical work. In the former the students' desks are arranged in groups of four, and are very completely equipped for electrochemical investigations. In the center of each group of desks is a large electrically-heated and regulated porcelain-lined thermostat. Each desk is provided with a 2, 12½, 25 and 110-volt circuit, rheostat, stirrer, gas, water and suction. Besides an equipment for analytical work, each student is given a complete set of electrochemical measuring apparatus, including a Weston ammeter and voltmeter with three scales, Lippmann electrometer, potential boxes, conductivity bridges, voltameters, etc. The whole class is thus able to work at the same time on subjects which are being concurrently discussed in the lectures, and thus, in conferences held weekly on the current work, to compare results of each other's experiences. The laboratory is also equipped with special arrangements for electrochemical analysis. Special rooms adjacent to the laboratory are equipped for measurements of electrical conductivity, dielectric constants, etc.

The laboratory of applied electrochemistry is equipped with a double-current motor generator of 25-kw capacity, which furnishes 1,000 amp. at 25 volts or 2,000 amp. at 12½ volts. Other voltages may also be obtained by varying the field of the generator. The generator is designed for electrolytic processes requiring large currents, such as occur in the manufacture of aluminum and of alkali. A storage battery of large capacity is also provided for depositions requiring currents at low constant voltage.

For processes requiring intense heat, but not electrolysis—for example, the manufacture of graphite, carborundum, carbides, etc.—the laboratory is provided with power from a single-phase alternator of 30-kw capacity, which, it is expected, will be still further increased another year. By means of a special transformer designed in the department this energy can be transferred from 160 volts to 10 volts in steps of 10 volts each. The transformer may thus be used to obtain any multiple of 10 volts desired. A complete set of alternating and direct-current electrical measuring instruments will be available for determining the electrical energy expended in the various processes studied.

The inauguration of a schedule of studies of the character outlined has been already justified by the call for men to fill electrochemical positions and by the number of students who have elected the course. Seventeen students were registered in October in the three upper classes, of whom eight are in the graduating class and two are graduates of other colleges.

The staff of the department has been strengthened for carrying out the new work by the return of Dr. Thompson, who made a tour of inspection of foreign electrochemical laboratories two years ago, and who has since been making a special study of electrochemistry at the Polytechnikum at Zurich.

The Chateaugay Water Power in the North Country.

WHILE much money and work are being expended upon the development of the larger water powers in this country, what is possibly an equal amount in the aggregate is being devoted to the utilization of smaller powers scattered all over the country, powers many of which are too remote or too insignificant to have attracted public general attention or to be known very far beyond their immediate vicinity. Of late years the United States has been gone over with a fine tooth comb by investigators and promoters looking for just such powers to develop, and there is no doubt that for some years to come they will afford opportunity to engineers and occupation to manufacturers, upon a large scale, although the units at any one of them may be spoken of as small as compared with those required at such places as Niagara or the Shawinigan.

FIG. 1.—VIEW OF DAM AND PENSTOCK FROM POWER HOUSE.

FIG. 2.—CHATEAUGAY CHASM BEFORE ERECTION OF DAM.

An interesting example of this class of work is found in the plant which has recently been installed in that section of New York State which Mr. Irving Batcheller, in his charming historical fictions, speaks of as the "north country." The Chasm Power Company, of Chateaugay has developed at that prosperous little village on the Rutland Railroad, a dozen miles from Malone, the county seat, a plant which is illustrated in the accompanying cuts and which has but lately gone into operation.

The Chateaugay Chasm is an outlet for the river and lakes of that name, as shown by our map. The river finds its way at this point through a narrow gorge hemmed in by walls of solid rock varying in height from 60 to 200 ft. Back of the river lies a chain of lakes furnishing an abundant supply of water under considerable head. The Chasm Power Company has built its dam just above the lower falls of the beautiful chasm and at the foot of the lower falls has located its plant. The dam is built of stone and cement to a height of 49.3 ft., making the distance from the top of the dam to the foot of the lower falls 88.7 ft. The penstock is 280 ft. long and 7 ft. in diameter, and as can be seen from the cuts is solidly built. The power house is of stone, 40 ft. by 60, built against the face of the cliff, and is so arranged that it and the penstock allow the installation of three hydroelectric units. The company has purchased of the Westinghouse Electric & Manufacturing Company a polyphase generator of 180 kw, as an initial equipment, but it is intended to install the two other units as soon as possible, as there is avail-

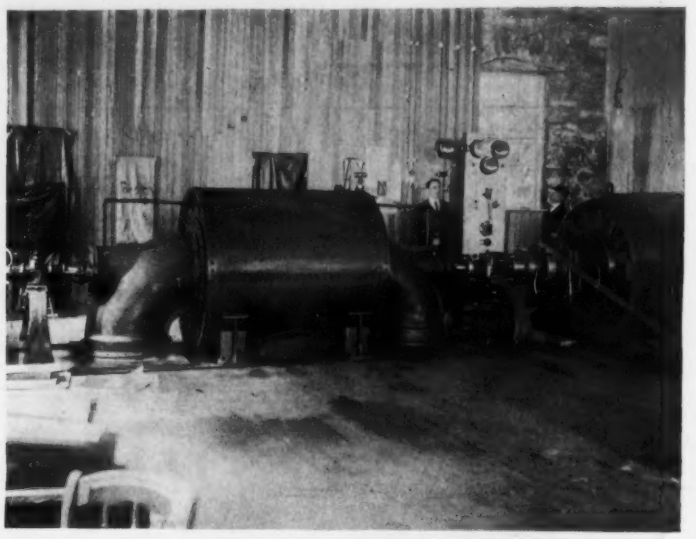


FIG. 3.—ONE OF THE UNITS.

FIG. 4.—POWER HOUSE, PENSTOCK AND CHASM FROM DAM.

able at least 1,000 hp on the spot and a feasible 2,000 hp is in sight. The water wheel was supplied by the Risdon-Alcott Turbine Company. It is intended not only to utilize this power locally, but to transmit it to the various points in the vicinity.

The generator is of the three-phase, 60-cycle type, current being generated at 2,100 volts and stepped down to 105 volts for light and power service. The turbine is of the cylinder gate type, capacity 300 hp under 84 ft. head, and is controlled by a Lombard governor. The current is already used for light, heat and motors, and the

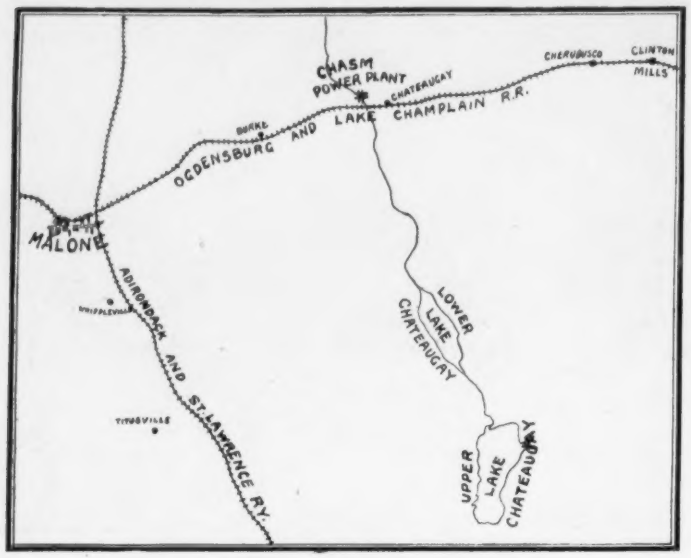


FIG. 5.—MAP OF WATER POWER REGION.

Chateaugay circuits have been running since July 1. The company is now building a line from Chateaugay to Burke, a distance of five miles. In order to develop business, and having but low fixed charges, the management is quoting liberal and low rates. The prices for lighting are on a flat basis, being $2 a year for 16-cp lamps for residences, and $3 a year for offices and business places. The rate for motors has been put at $20 per year per hp. As might be expected, there is not a great deal of manufacturing in the immediate vicinity, but with cheap power, living and rents, and intelligent labor, the company helieves the conditions are attractive for industries of various kinds. Besides, as the beauties of the gorge and chasm remain undisturbed, except at this particular point, the tourists to the vicinity can now enjoy all the advantages of electricity, not previously obtainable.

The company has been organized with a capital of $35,000 and secured for less than $4,000 its water power privileges and power house site. The president of the company is Mr. C. L. Bentley; the vice-president, Mr. W. B. Ryan; the secretary, Mr. A. B. Cooney, and the treasurer, Mr. E. S. Duffy.

Talking with London.

A special cable dispatch to a New York daily paper from London of November 14 says with uninformed optimism: "Prophecy is dangerous, but with a full realization of its pitfalls the correspondent of the *Sun* ventures the following prediction: Within three months, probably before New Year's, direct telegraphic communication, without intermediate repeating stations, will be established for the first time between New York and London, and telegrams will be exchanged at a speed of more than four times the previous capacity of any cable. I am tempted to go a step further and express the strong expectation that within a year it will be feasible to converse by telephone between New York and London as it is across Manhattan. Perhaps it is as well to confess that it is easy to prophesy when you know. The feat of rapid communication between London and New York as a matter of fact has been greatly surpassed recently in actual practice; in other words, the problem of cheap and rapid long-distance communication has been solved, and the credit for this signal triumph of modern science belongs to England. I am compelled to await the permission of the inventors before making more than this general announcement."

Direct-Current Traction at 1,200 Volts in France.

It is well known to our readers that Mr. R. Thury, of Geneva, Switzerland, has done a great deal of interesting work with direct-current power transmission at high voltages. At a time when the

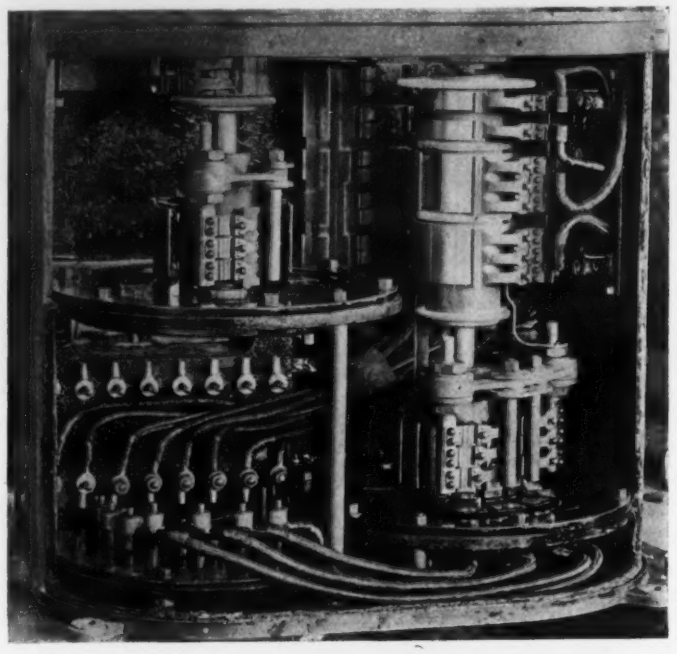


FIG. 1.—CAR CONTROLLER.

application of high-voltage alternating current to traction work is under discussion, a further effort of M. Thury and his associates is worthy of note, being nothing less than the operation of a trolley system in Southern France with direct current at 1,200 volts. The road and its details are illustrated herewith.

The line in question extends between St. Georges de Commiers and La Mure, about 20 miles apart, near Grenoble, and its main business appears to consist of freight. Hitherto the work has been done with steam locomotives, but as there is abundant and cheap water power in the vicinity, electricity has been resorted to, and the first of the new locomotives is now in service. It weighs about 50 tons and is of 500-hp capacity, there being in fact four motors

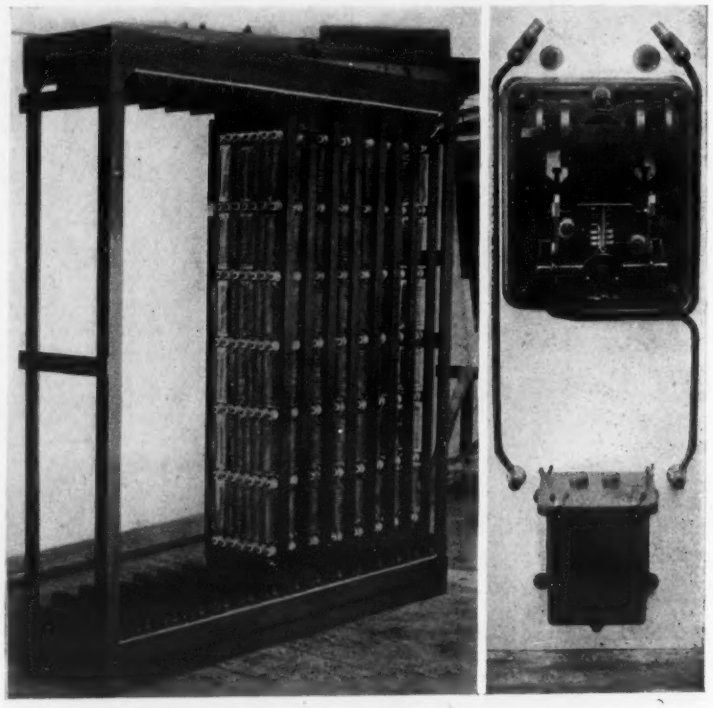


FIG. 2.—RESISTANCES AND CIRCUIT-BREAKER.

of 125-hp capacity each, two on each truck. These are connected in series and require 185 amp. at 625 volts. The line is equipped on the three-wire system so that the voltage between the outside wires

is 2,400 volts. A diagram of the three-wire connections is shown. The road—of 1 metre gauge—is a grade with slight slope, and the loaded train comes down with the motors arranged to run as generators and act as brakes, being connected to the resistances. For breaking the circuits, oil switches are used. Hauling 20 cars of a

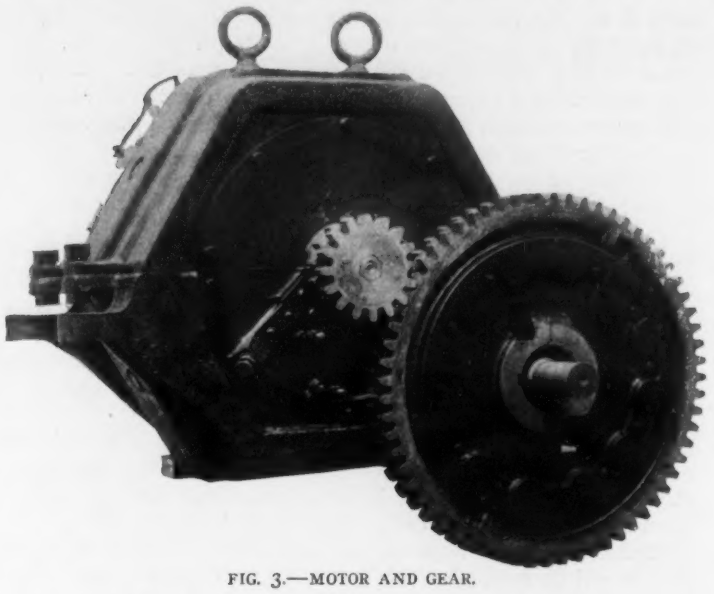


FIG. 3.—MOTOR AND GEAR.

gross weight of 111 tons, the locomotive makes a speed of about 22 km. per hour on the 2¾-per-cent. grades. The motor and gear are shown in Fig. 3.

The overhead construction is solid, with double contact wires and double sets of Siemens sliding bone contacts, under the slight upward pressure of 2 kg. The overhead line consists of two "figure 8" copper wires, 114 mm. cross section, in span on wooden poles. As already stated, the voltage is 2,400 volts between the outside wires, and 1,200 volts between each contact wire and the rail forming the neutral. Thury direct-current motors have, however, been successfully built and operated up to 3,600 volts.

A car controller is installed at each end of the central cabin of the locomotive, of the type shown in Fig. 1. Special care has been taken with insulation in view of the high voltage used, and as will be seen a large number of contacts are provided through the combination of the two sets. One shaft carrying 12 contacts and the other 8, no fewer than 96 steps are obtainable. The resistances employed in association with the controllers are carried in the motorman's cabin and are built up as shown in Fig. 2. These are large enough to absorb easily the electric braking current produced by the locomotive on the descent when the motors are run as generators. The locomotive has also a hand braking system and an air system for which the compressor is driven by a small motor of 4 hp, at

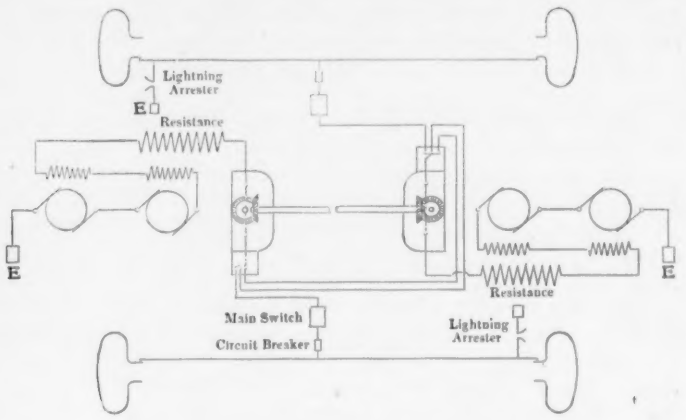


FIG. 5.—DIAGRAM OF CONNECTIONS.

1,200 volts. The circuit-breaker, oil switch, fuses, etc., are shown in Fig. 2.

The electrical construction of this interesting system was executed by the Compagnie Generale de Construction and by the concern operating under the Thury patents, i. e., the Compagnie de l'Industrie Electrique et Mecanique de Geneve.

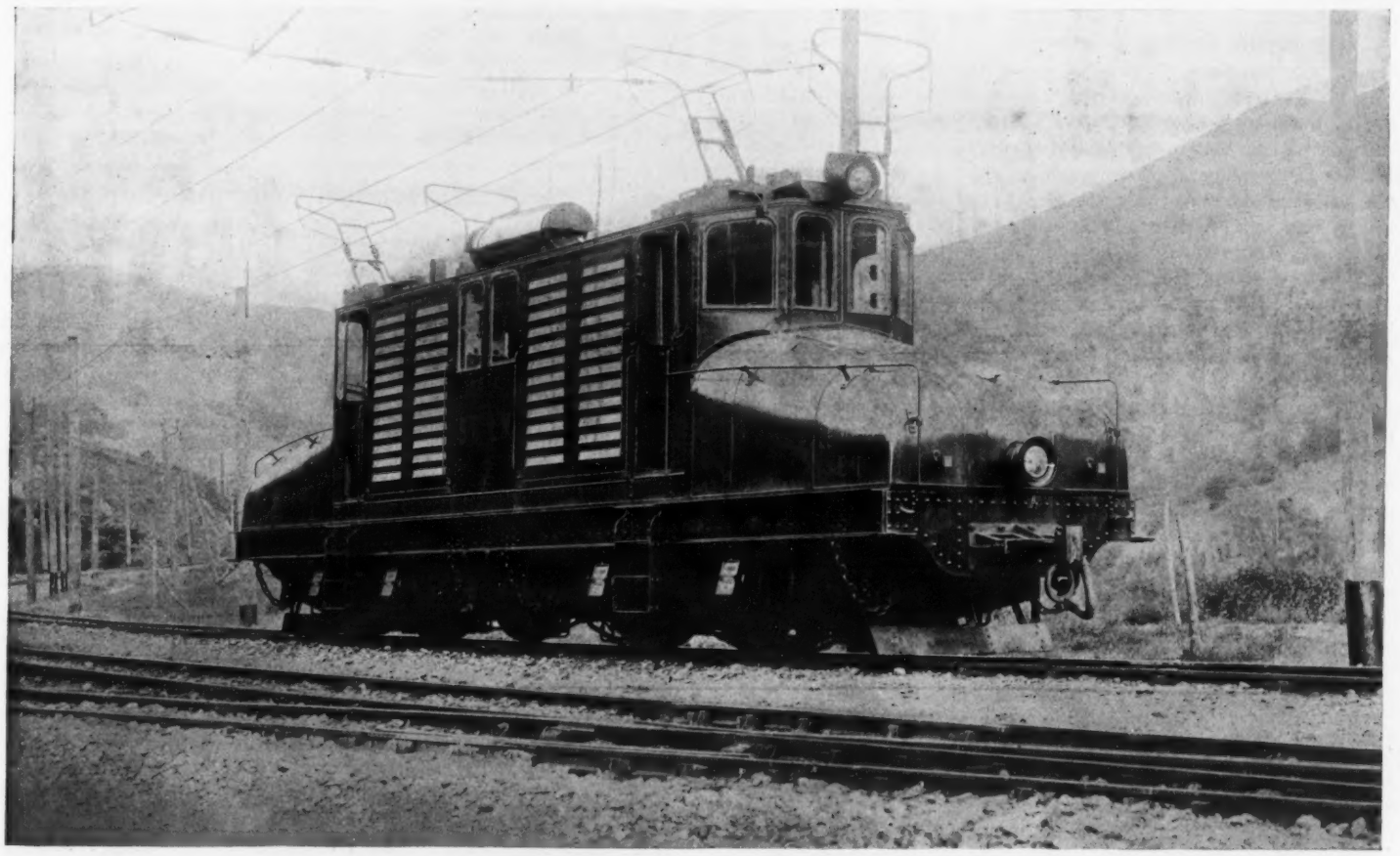


FIG. 4.—GENERAL VIEW OF LOCOMOTIVE.

New York Central.

A section of the Rome, Watertown & Ogdensburg Railroad which is leased by the New York Central Railroad is to be equipped with electricity immediately and the electric cars of the Central system will be run to and from all points along the southern shore of Lake Ontario.

Melting Sleet on a Third Rail.

BY W. A. DEL MAR.

FROM time to time electric heating as a method for removing sleet from the contact rail has been suggested. The idea seems an excellent one at first thought and engineers have been tempted to make experiments with the view to finding the quantity of electrical energy required for the purpose. These experiments have always shown that the energy required to heat the rail is exceedingly large, and principally on this account the method has never been adopted. The object of this article is to show why this large amount of energy is required.

It is a difficult matter to show just what expenditure of energy would be necessary to raise the temperature of the rail a certain number of degrees, but it is easy to show that a large amount can be expended without appreciably affecting the temperature.

When one pound of water has its temperature raised one degree Fahrenheit above the air, it absorbs about one thermal unit, equivalent to 0.2835 watt-hour. The specific heat of iron being only about 0.114 that of water, one pound of rail will absorb but 0.0323 watt-hour when its temperature is raised one degree. Now, it can be assumed that in order to melt ice from a contact rail, the temperature must, under fairly normal conditions, be raised at least ten degrees Fahrenheit. A system for heating the rail which would fail a few degrees below freezing point would scarcely be worth installing, so that this assumption of ten degrees rise is quite a moderate one. From the figures given above it appears that in order to heat one pound of rail ten degrees Fahrenheit in one hour, 0.323 watt-hour would have to be used, regardless of the losses by radiation, convection, etc. On a 100-pound rail this amounts to 10.75 watts per foot on the assumption that no heat is lost in any way whatsoever; but in actual cases the losses are very great.

The heat radiated from a square foot of rusty iron is found by experiment to be about 0.7 B.T.U. per hour per degree Fahrenheit difference of temperature between the iron and air—provided that such difference does not exceed 30°. This is equivalent to 0.198 watt per sq. ft. per degree. Now, on one foot of 100-pound rail there are 2.08 square feet of surface. Hence, the radiation per foot of rail will amount to 0.412 watt per degree. This does not allow for losses by convection, evaporation, etc. Assume that in heating the rail ten degrees the average difference between the air and rail is five degrees. The radiation will then be at the rate of about 2.1 watts. If this quantity be added to the heat used in raising the temperature of the iron, a total of nearly 13 watts is obtained as the power necessary to heat one foot of 100-pound rail ten degrees in one hour. On a railway having fifty miles of 100-pound contact rail, this would amount to 3,432 kw, assuming a dry rail, no ice to melt and no loss by evaporation and convection. This quantity has to be greatly increased in order to supply energy for melting the ice.

One pound of ice at 32° F. requires the expenditure of 142.65 B.T.U. to melt it without raising its temperature. This is equivalent to 40.44 watt-hours. Hence, in order to melt one pound of ice in one hour, 40.44 watts are required. A deposit of sleet or snow one-eighth of an inch thick covering two-fifths of the surface of a 100-pound rail, weighs about half a pound per foot. Hence on 50 miles of contact rail there would be 132,000 pounds which is to be melted in one hour would require a provision for that period of 5,280 kw. This is assuming a heating efficiency of 100 per cent.; that is, neglecting losses by convection, radiation, etc.

In the case of a sleet deposit, it would of course not be necessary to melt a film one-eighth inch thick, for if a film, say 1/100th inch thick were melted, the remainder would be so loosened as to be easily removed with a brush or scraper. A film 1/100th of an inch thick on ⅖ of the rail surface would weigh 10,560 pounds on 50 miles of 100-pound rail. Assuming a heat efficiency of 100 per cent., this would require to melt it in one hour, a provision of about 427 kw. This would merely supply the latent heat in melting. If the rail were kept 10° F. hotter than the air, the radiation in one hour would require at least 550 kw, assuming a perfectly dry rail. In order to heat the rail 10° F. in one hour about 2,830 kw are required, assuming no losses. Thus the minimum power required to melt 1/100th of an inch of sleet from 50 miles of 100-pound rail, amounts to at least 3,800 kw. This neglects two of the greatest sources of heat loss, namely, loss by evaporation and by wind convection. It is possible that there might be conditions under which it is not necessary to heat the rail 10° F., but a sleet melting system would not be worth installing if it could fail at such a moderate temperature as 10° below the freezing point, besides which in practice the ice would have to be melted in much less than one hour.

Experiments with contact rails have shown that if the rail is kept moist with water 10° hotter than the air, the temperature of the rail will not rise even if 16 watts per square foot are expended on it. With 100-pound rail this is 32 watts per foot length. This power on fifty miles of rail amounts to about 8,500 kw. Thus practice shows that an expenditure of 8,500 kw on 50 miles of 100-pound rail has no effect in heating the rail, regardless of the important matter of melting ice.

It might be suggested that it is useless to heat so much rail at a time; that in fact it might be better to heat one section at a time and then go on to another. This is impossible, however, owing to the low heat storing quality of iron. As shown above, the heat capacity of a foot of 100-pound rail is only 10.75 watt-hours, a quantity that would be dissipated in a few minutes. Not only is the cost of energy for electrically heating the third rail enormous, but the cost of apparatus for generating, transforming and distributing this energy is quite absurd, considering the doubtful value of the system under the best conditions.

Contrast the electrical method with the use of hot water. One pound of ice at the melting point can be melted by using 142.65 B.T.U. A deposit of ice ⅛ inch thick on ⅖ of the surface of 50 miles of 100-pound contact rail weighs 132,000 pounds. To melt this 18,829,800 B.T.U. are required. If water at 180° F. be used, 104,590 pounds will be required. This is about 1,700 cubic feet at a heating efficiency of 100 per cent. Assuming the heating efficiency to be only 10 per cent., the number of cubic feet required will be 17,000. If the ice be below the freezing point, a few cubic feet must be added to this. Suppose it to amount to 20,000 cubic feet, which can be contained in a few tank cars of moderate size. Of course, in order to prevent this water freezing on the rail, it must contain salt or some other substance that lowers the freezing point of water. There are serious objections to the hot water method, but these may yet be overcome, and then the sleet scare will be relegated to the past with the scores of other bugbears that have worried engineers and set inventors to work on ideas barren and futile.

The Induction Coil Spark.

BY ALFRED G. DELL.

Some years ago I pointed out in an article that it is better to change the wires of the secondary of an induction coil, where a reversal is wanted, than to reverse the primary current. At that time I had been occasionally using an induction coil interrupter consisting of a platinum point and a spring with a flat piece of platinum striking against the point when making and breaking the circuit. The platinum was frequently cleaned. I found that there was generally a change in the length of the spark in the secondary whenever I reversed the primary current. At the time I did not know the cause of the change in the spark length, but since seeing the note in the Digest of September 19, 1903, on "Assymmetry of the Mercury Break," I am enlightened.

It is well known that when a spark is made between a point and a plane surface, the spark is longer when the point is positive and the plate negative (See "Experiments with Electric Waves," ELECTRICAL WORLD AND ENGINEER, May 18, 1895). When the point is negative and the plate positive, the self-induced discharge should be positive from the point and negative from the plate, in which case the spark of self-induction should be longer than when the current is in a reverse direction, and it would take more condenser capacity to break up the spark than in the latter case. The self-induced discharges could not be of the same sign, and the back rush, or dying away, of the current would certainly reverse the signs of the self-induced discharges. The above appears to be a simple explanation of the change in the spark length.

I have also found, when the break is composed of two round platinum wires, and the current has been used in one direction for some time, that there is a slight difference in the secondary spark length when the current is reversed. On examination of the break point I found that one side had a sharp point raised, fitting into a hollow in the other, which would account for the difference in spark length. It called to my mind the condition of two arc light carbons with a direct current.

Calculation of the Apparent Inductance of Armature Coils.—II.

BY C. C. HAWKINS.

Class *IB*. The nature of the figures obtained in this class entirely depends upon the value of the fraction by which $\frac{slots}{2p}$ exceeds a whole number. The smaller this remainder, the nearer can the pitch of the coils be brought to equality with the pole pitch in slots, and by this criterion the cases may be arranged in a sequence of progressive divergence from the diametric case with interchangeable coils. If the remainder is $< \frac{1}{2}$, it is possible for the two spool sides in each of a pair of consecutive zones to fall within the same slot, so that for values below $\frac{1}{2}$ we have very long chord if the rear pitch has its maximum length, or symmetrical long if shortened by one tooth, while for values of the remainder from $\frac{1}{2}$ upwards we have what has been above defined as asymmetrical long or short chord arrangements according to the span. A table of values of the remainder can, therefore, be drawn up as below, which for the case of completely interchangeable coils indicates to which class any winding must be assigned.

	Remainder giving very long or sym. long.		Remainder giving asym. long or asym. short.		
2 spool sides per slot.			Not possible.		
4 " " " "			½		whatever the no. of poles.
6 " " " "	⅓			⅔	with 6 poles.
8 " " " "	¼		½	¾	with 4 or 8 poles.
" " " " "			½		with 6 poles.
10 " " " "	⅕	⅖	⅗	⅘	with 10 poles.

With bar armatures or with non-interchangeable coils, any of the above fractions can yield diametric winding or symmetrical long and short-chord windings if the pitch is shortened.

In class II, with $\frac{N_2}{2p}$ fractional, the subdivisions are in exactly the same way dependent upon the remainder which the fraction $\frac{slots}{2p}$ leaves. For example, with six spool sides per slot the possible cases are as follows:

	Remainder giving very long or sym. long.		Remainder giving asym. long or asym. short.			
			½			with 2 poles.
	¼		½	¾		with 4 poles.
6 spool sides per slot.	⅙		½		⅚	with 6 poles.
	⅛	¼ ⅜	½	⅝	¾ ⅞	with 8 poles.

By comparison of the simpler diagrams it is seen that as we proceed down the scale from the longer to the shorter chords, the process is as it were a gradual *shearing* apart of the two layers of wires from their highest degree of concentration in any one class.

In class I, for the same value of s the brush contact may have any width between a minimum of $(s\text{-}1)$ sectors $+$ (s) micas and a maximum of (s) sectors $+$ $(s+1)$ micas; but of the two limits the latter is the better, since the time of short-circuit always increases in direct proportion to the width, yet the $L + \Sigma M$, even under the least favorable conditions, is never increased quite in the same proportion. The same argument might equally well be used to prove the advantage of a wide brush so as to short-circuit a large number of sections; yet although on paper this is true, it must be borne in mind that in practice a limitation is set by the short-circuited coils coming under the pole tips, or even filling the entire interpolar zone; when this is the case, many of the assumptions made no longer hold in their entirety, and other secondary reactions upset the conclusions that might otherwise be drawn.

In class II, for the same value of s, there is again a maximum and a minimum value of the brush width, and *different* numbers of short-circuited spool sides may result, according as the widths approaches the lower or the upper limit. It is, therefore, necessary to select a fixed relation for comparative results, and in all the diagrams for this class, the average is taken by which the brush width is $(s - \frac{1}{2})$ sectors $+$ (s) micas.

5. *Calculation of slot inductance.*

The *slot inductance* is easily elaborated from a few simple cases. Thus with a single spool side containing w wires at the top of a slot (Fig. 11), within the region of its own depth, which is practically equal to $\frac{t}{2}$, the self-induced flux across the slot is increasing in density at a uniform rate as we advance upwards towards the opening; at the same time the wires with which this flux is linked are also increasing at the same uniform rate. The integral of the line linkages for one C.G.S. unit of current or the inductance is then

$$\frac{4\pi}{3} \times w^2 \times \frac{t}{2\,w_s} \times l = 4.19\, w^2 \frac{t}{2\,w_s} \times l.$$

Let a short-circuited spool side be now added in the lower layer (Fig. 12), its wires being shaded in order to distinguish it from the considered section of which the wires are black; a certain amount of mutual inductance is thereby added. The flux due to the second

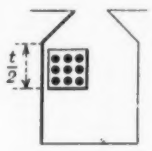


FIG. 11.

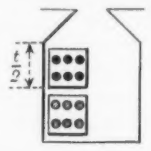


FIG. 12.

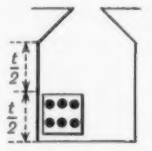


FIG. 13.

spool side has a uniform density across the upper half of the slot, but the black wires with which it is linked gradually increase. The integral of the line linkages, or the mutual inductance, is then

$$\frac{4\pi}{2} \times w^2 \times \frac{t}{2\,w_s} \times l = 6.28\, w^2 \frac{t}{2\,w_s} \times l.$$

If now the considered spool side be at the bottom of a slot (Fig. 13), within the lower half of the slot to the height $\frac{t}{2}$, there will be the same flux and the same inductance due to it as in our first case, but to this has now to be added a further self-induced flux of uniform density in the upper half of the slot linked with all the wires; whence the additional inductance is

$$4\pi \times w^2 \times \frac{t}{2\ \ s} \times l = 12.57\, w^2 \frac{t}{2\,w_s} \times l.$$

If in either of the two layers there are j spool sides short-circuited instead of the single one above shown, it is only necessary to multiply the corresponding item by j. The three leading cases when expressed in a form immediately applicable to our equation are, therefore, as follows:

(x) If the flux density across the slot and the wires with which the flux is linked are both increasing, the inductance per cm. length of core is $\left(\frac{\tau}{N_2}\right)^2 \times 0.52\, j \frac{t}{w_s} \times 10^{-9}$ henrys.

(y) If one is constant and the other is increasing,

$$\left(\frac{\tau}{N^2}\right)^2 \times 0.785\, j \frac{t}{w_s} \times 10^{-9} \text{ henrys.}$$

(z) If both the flux density and the wires with which the flux is

linked are constant, $\left(\frac{\tau}{N_2}\right)^2 \times 1.57\, j \frac{t}{w_s} \times 10^{-9}$ henrys,

while the inductance per cm. of core from the flux across the opening of the slot due to j short-circuited spool sides within the slot is invariably

$$4\pi\, w^2\, j \frac{t_s}{w_s} = 12.57\, w^2\, j \frac{t_s}{w_s} = \left(\frac{\tau}{N_2}\right)^2 \times 3.14\, j \frac{t_s}{w_s}$$

The four cases enumerated above rise in the proportion $\frac{\pi}{6} : \frac{\pi}{4}$ $\frac{\pi}{2} : \frac{\pi}{1}$, and into these elements any complicated case may be resolved. Thus, if one neutral zone be considered alone in the first

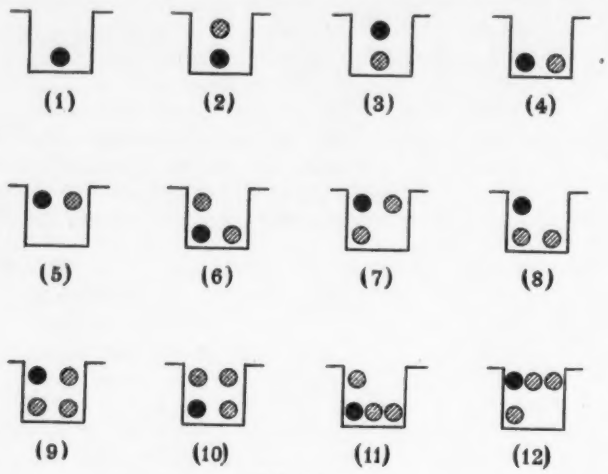


FIG. 14.

place, the values of the coefficient, a, for the different cases of Fig. 14 are:

(1) $a = x + z = 2.09$,
(2) $a = x + z + y = 2.88$,
(3) $a = x + y = 1.31$,
(4) $a = 2(x + z) = 4.19$,
(5) $a = 2x = 1.04$,
(6) $a = 2(x + z) + y = 4.975$,
(7) $a = 2x + y = 1.825$,
(8) $a = x + 2y = 2.09$,
(9) $a = 2(x + y) = 2.62$,
(10) $a = 2(x + z + y) = 5.76$
(11) $a = 3(x + z) + y = 7.055$,
(12) $a = 3x + y = 2.345$.

In Fig. 10 tables of the value of a for the pair of zones are given for each case, from which will be seen the progressive reduction as the winding is spread out for any given value of s. The value of a' for any slot is quickly found by simply counting the number of short-circuited spool sides in the slot which contains the considered section (marked black) and multiplying this number by 3.14; it hardly requires, therefore, to be tabulated.

The International Wireless Telegraph Conference.

Mr. John I. Waterbury, United States delegate to the recent international wireless telegraph conference, has contributed to the November *North American Review* an article summarizing what was done or proposed at Berlin last August. His statement is as follows, as noted editorially last week:

The 4th of August was fixed and forty-three delegates were assembled, eleven being from Germany, three from Austria, three from Spain, three from the United States, six from France, four from Hungary, four from Italy, three from Russia. The proceedings were conducted in French, and the *Avant Propos,* or programme of discussion, consisted of a series of propositions and sub-articles covering the details of each. The first was to cover the point as to whether any company should be allowed to act as the Marconi Company had acted, and the others dealt with minor matters regarding distressed ships, tariffs, men-of-war, etc. Broadly speaking, the first was the only real question, the others being entirely subordinate, and there was much carefully prepared argument and discussion. On the one side, elaborate arguments were made to show that the Marconi Company really lead the world, and that, if their stations were compelled to receive messages from inferior apparatus, not only would they be unjustly injured in their interests, but the world's good service would be jeopardized: that it was too soon to think of formulating rules to fetter a new discovery in its development; and that, if the Marconi Company had won any advantage over their rivals, it was by fair business competition in which their rivals had been so far worsted.

On the other hand, it was held that the Marconi Company had declined to compete with any one else over the same proving ground; that their claimed superior results were no better than those obtained by officers of the different governments there represented; that it was well known that other people could communicate as satisfactorily as Marconi could, and that it was not too soon to recommend the formulation of some rules which would prevent the Marconi Company from developing a world monopoly which would stifle all independent research; the fact being that whereas cable companies only exploit telegraphy by means of cables, and do not manufacture cables or the apparatus for signalling, the Marconi Company were not only endeavoring to monopolize the exploitation of wireless telegraphy, but also of the apparatus by which such signals are made and received.

The discussion was very interesting; and, when it came to voting, the action of the various governments was a curious study. All the European nations have a government monopoly of all means of communicating information by electricity; and the vote of France, Germany, Austria, Hungary and Russia was prompt against the Marconi monopoly. Italy was in favor of the Marconi Company, being bound to it by a contract in consequence of Marconi's having, in Italy's opinion, the most perfectly organized system and the best apparatus. England held her decision in complete reserve, but signed the minority report with Italy, on the ground that, though the British Government had a monopoly of the telegraph, this authority was not supposed to extend beyond the marine league, and Marconi and every one else had a perfect right to operate wireless telegraphy between the coast and ships at sea, and make such rules as they chose regarding each other without interference from the government.

The United States delegation held, first, that the United States Government had paramount authority over any wireless telegraph association doing business either between the States of the Union or with foreign countries; and, second, that any such organization came under the common carrier law, which, by decision of the Supreme Court, compelled any one coming under that law to receive and transmit messages from any suitably equipped vessel or station. The vote of the delegates of the United States was thus cast with the majority.

Another very curious question raised and argued at great length was, whether the Marconi Company was entitled to an indemnity in case the recommendation of the majority became law. Italy was in favor of an indemnity. England would not admit an indemnity, but suggested that a surtax would be reasonable on all messages sent by rival apparatus. The other nations, including the United States, were against either an indemnity or a surtax, the idea of the United States delegates being that neither the Marconi Company nor any one else was entitled to an indemnity or surtax because they had erected stations on our soil without having consulted our laws.

Minor matters, such as rates, and what part should go to the ship and what to the shore stations, were discussed *pro* and *con;* but, as the laws of the United States permit the utmost latitude in such matters, the United States delegates considered that business alone would ultimately regulate them, and that it was a matter of too small importance to discuss at the present time. The European nations held somewhat different ideas, because of their absolute control in such matters; but the general idea prevailed that the tariff should be equitable and in proportion to the telegraphic work done.

The work of such a conference as this could be at best but preliminary, as its name indicates; but the result of the examination, for the first time, of the wireless telegraphic situation as it is to-day points very clearly to the advisability of a subsequent congress, whose delegates shall be fully instructed and endowed with sufficient authority to go more deeply into the question in all of its relations.

The Choice of Wattmeters.

BY PAUL MACGAHAN.

MUCH has recently been written concerning the increased amount of revenue obtained by companies supplying electricity to the public, owing to the adoption of the more modern and accurate wattmeters that have lately become available. Cases have been cited of lighting companies being remunerated for from 40 per cent. to 65 per cent. of the total power generated, thus obtaining a sufficient increase over former revenue to convert their stock from a doubtful investment to one paying excellent dividends.

This has opened the eyes of progressive station managers to the progress of events, and most of them have already abandoned the wattmeters in vogue five or ten years ago, replacing them by the newer types. To those who have not yet decided which of the modern wattmeters to adopt, or who have reason to believe that they have decided wrongly, the following notes regarding comparative features may be of interest:

It is well known that the most important reasons why the total power delivered to the consumer is not paid for are, first, that at light loads the old types of wattmeters run entirely too slowly or actually not at all; and, second, that these same meters run too slowly at all loads owing to increased friction from wear. It is very seldom that a meter is found running faster after any considerable period of service, as such a condition can only be due to an aging of the permanent magnets, and in the present state of the art of making magnets the aging, if any, is very slight.

Many wattmeters are loaded the greater portion of the time to only 10 per cent. to 20 per cent. of their normal capacity, and it is evident that an error under such conditions may become a very serious thing, yet none of the old-style wattmeters, after a month or two of such service, could show an error less than 10 per cent. to 25 per cent. at light loads.

The sale of alternating current for power purposes has brought about problems of correct registration at low power factors, and with varying frequencies, wave forms, voltages, loads and temperatures. Each of these causes produces its own error, and all added together give the maximum error in registration. When it is stated that a wattmeter is accurate within 2 per cent., it is meant that all these causes, each of a magnitude such as would be found in actual operation, and all acting in unison, produce a resultant error not exceeding 2 per cent.

The ideal wattmeter, to meet the requirements of the station manager, should sustain the highest possible initial accuracy over its whole range during its term of service. It should also be dust, water and insect-proof, and so constructed as to make tampering impossible.

To obviate the latter contingency, there should, of course, be provision for the electric light company's seal. It would also be a great advantage if the wattmeter is sold, sealed by the manufacturer, so that in case of a dispute with a customer, his seal and guarantee could be referred to as proof of calibration by a responsible and disinterested party. Moreover, a manufacturer cannot in self-protection guarantee a wattmeter not sealed by himself, and therefore cannot be expected to make repairs without charge, as it would be impossible to detect any change in adjustment after leaving his hands. It is evident, therefore, that an unsealed wattmeter is unguaranteed.

The only excuse for a manufacturer supplying unsealed wattmeters is in cases where their moving element is so heavy that the jewel bearings would not stand the rough handling due to shipment, and has to be inserted after the wattmeter is in place. It should be understood, of course, that the manufacturer's seal does not prevent the purchaser from repairing his own wattmeters if he so desires.

In testing a wattmeter for initial accuracy, observations should be made at the extreme variations of voltage, frequency, power factor and temperature likely to be met with in the electric light company's distributing system. Curves should be plotted under each condition for various loads from 1/50 to 1½ times full load. It is very important to see that the meter will not creep on shunt current alone, or that at least it should not from this cause make a full revolution of the disc; half a revolution of creeping is unimportant, as it may be due to a mechanical unbalancing of the disc.

Care should be taken also that the measuring apparatus used should be suited to the capacity of the wattmeter under test. Thus it would be quite absurd to test a 5-amp., 100-volt wattmeter down to 50 watts or less, using a 1,500-watt indicating instrument for a standard, as the latter cannot be read with sufficient accuracy on less than 200 watts. It should not be forgotten that an integrating wattmeter has a range of legibility several times as great as that of any indicating instrument now on the market. Therefore, when indicating wattmeters are used as standards, about three instruments of different capacities should be used for testing an integrating wattmeter at different loads.

Overload capacity is an important consideration in the selection of a wattmeter. It permits the use of a smaller meter, thus increasing the accuracy of registration at light loads and decreasing the cost of the meter equipment. Thus when a house having an installation of 20 100-volt lamps is to be metered, a 5-amp. wattmeter having reasonable overload capacity is entirely sufficient, for generally only 5 to 10 lamps will be burning at one time. The meter should be able to carry a load of 15 lamps (7½ amp.) continuously with accurate registration, and 20 lamps (10 amp.) for a short period without danger of injury.

It would necessitate a long running test extending over several months upon many wattmeters of different makes to obtain an actual experimental comparison of the light-load permanency of any one of them, but fortunately this quality can be judged accurately at the start by giving attention to the following considerations:

The moving element being supported on a delicate jewel, and driving a train of gears, friction of the jewels and gears is inevitable, and is generally compensated for at calibration. This friction is a variable quantity and is dependent upon the wear. Therefore, as the wear increases, the wattmeter will gradually fall behind, as the initial friction compensation remains constant.

It is hardly necessary to consider the friction of the recording train, as the speed of the wearing surfaces is exceedingly small, and the torque overcoming the friction is comparatively enormous, due to the multiplication, or leverage of the gears. Thus when the torque at the disc is 1 cm.-gm, the torque at the first dial would be from 1,000 to 10,000 cm.-gm., and ten times more at each succeeding dial. As a matter of fact, when a wattmeter having a properly designed and constructed recording mechanism is stripped of its gear-train, the most delicate tests fail to measure any diminution in the friction.

Thus the all-important consideration is the weight on the jewel bearing and its effect on the accuracy of the recording mechanism. In the case of the ordinary cup jewel and pivot, the amount of weight supported by the bearing is of the utmost consequence. The greater the weight of the moving element, the more rapid the wearing of the jewel and pivot, and the greater the danger of cracking or otherwise damaging the jewel by jarring during or after shipment. Thus, for instance, the weight upon the jewel is doubled, trouble therefrom is enormously increased.

It should be remembered in this connection that watches are not made accurate by powerful springs, giving strong driving power or torque, but by careful jeweling and light moving parts, and that, from the similarity of mechanism, the same principle would hold true for wattmeters. Light weight of moving element should, therefore, be of primary importance. It is also desirable as an adjunct of this light weight, that the driving power or "torque" of the meter should be a maximum. The greater the torque the smaller will be the effect of friction upon speed. For example, a wattmeter with full-load torque of 10 cm.-gm. and uncompensated friction of 1 per cent., or .1 cm.-gm., will require 1 per cent. of full load current to start; and as the friction is approximately a constant quantity at all loads, the meter will record 50 per cent. slow at 2 per cent. load, 25 per cent. slow at 4 per cent. load, etc. If the torque should be increased to 20 cm.-gm. at full load, without an increase of friction, the meter starting with ½ per cent. load will record 25 per cent. slow at 2 per cent. load, 12 per cent. slow at 4 per cent. load, etc.

There are two methods of obtaining a high torque in the induction wattmeter, the first and easiest being by increasing the amount of metal in the disc, thus reducing its resistance and increasing the induced current. But by this means the weight and torque increase together and no advantage is gained, as the ratio of torque to weight remains the same, and the friction effects and jewel troubles increase enormously. The second and correct method is to increase the electrical efficiency of the motor element driving the disc.

It must be borne in mind, therefore, that a high torque, which has been shown to be a desirable element in a wattmeter, may be present solely on account of the heavy moving parts which have been shown to be objectionable. It is only by keeping the moving parts as light as possible and the torque relatively high that the best results are obtained.

Transposition of Telephone Lines: Cross-Talk and Induction.

AT the annual meeting in New Orleans of the Association of Railway Telegraph Superintendents, Mr. Frank F. Fowle, of the engineering staff of the American Telephone & Telegraph Company, read a paper with the above title, which forms an interesting contribution to the subject of telephone line disturbances arising from reactance and leakage.

The introduction treats of the four properties of transmission lines—resistance, inductance, leakage and capacity. The well-known formulæ for the inductance and the capacity of a single aerial wire and an aerial metallic circuit of two wires were given, with mention of the conditions under which the formulæ hold true, and of the effect of wire insulation and the presence of adjacent parallel circuits. The distribution of the energy in a transmission line was explained, it being pointed out that the resistance and the leakage reactions are dissipative and are sources of energy loss, while the inductance and the capacity reactions are non-dissipative and are, directly or indirectly, the means whereby energy may be transmitted. For

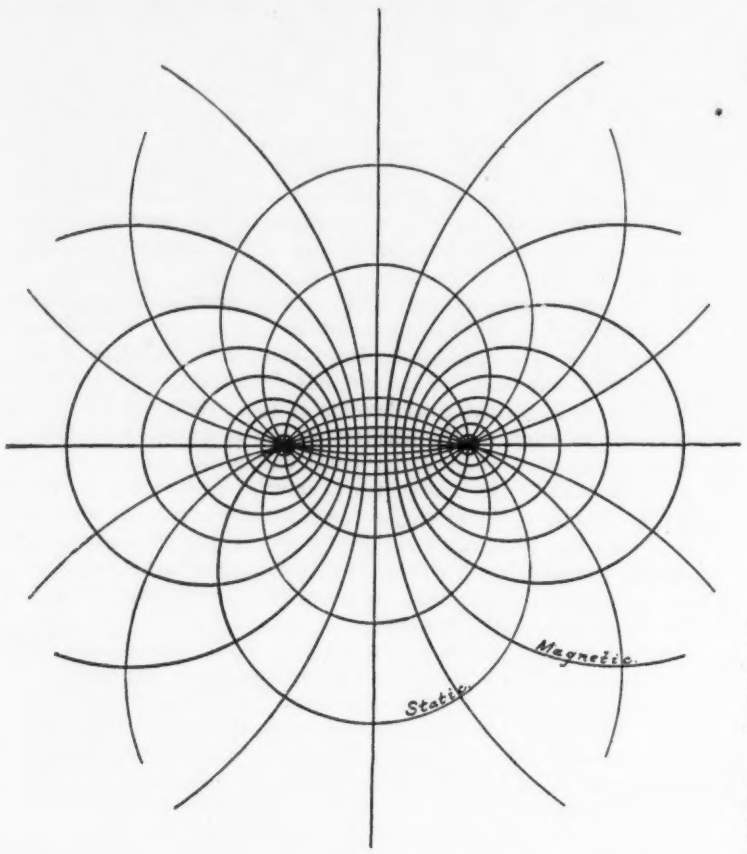


FIG. 1.—STATIC AND MAGNETIC FIELDS OF A METALLIC CIRCUIT.

telephonic transmission a line is of greatest efficiency when the inductance and the insulation resistance are each a maximum, and when the resistance and the capacity are each a minimum. That is, the resistance reaction should be small and the inductance, leakage and capacity reactions should be great. The line wires serve as a guide and the energy is propagated principally in the dielectric immediately surrounding the wires. The total storage capacity for energy, per mile of line, is exceedingly small, but the velocity of propagation is slightly less than the velocity of light, on ordinary lines of small inductance, and a transmission line is virtually a small energy reservoir operated at an enormous velocity.

The field about a metallic circuit of two aerial wires may be investigated from the equation,

$$F = 2I\left(\frac{1}{r_1} - \frac{1}{r_2}\right) \qquad (1)$$

where F is the force at a point perpendicularly distant r_1 from one wire and r_2 from the other wire, and I is the current traversing up one wire and down the other; and the further equation,

$$V = 2q_1 \log \frac{r_2}{r_1} \qquad (2)$$

where V is the potential at a point perpendicularly distant r_1 from the wire whose charge is q_1 per unit length and distant r_2 from the other wire. Fig. 1 shows the field about such a line.

The lines of magnetic flux are also the equipotential lines of the static field. If the perpendicular straight line in Fig. 1 be taken as coincident with the surface of the earth the distribution of the field above the earth is that for a single aerial wire employing an earth return. The intensities of the magnetic and the static fields diminish very rapidly at distances away from the circuit a few times the separation between the wires or between the wire and the earth. How this intensity varies along the X axis is shown in Figs. 3 and 4 in the paper, calculated from expressions (1) and (2).

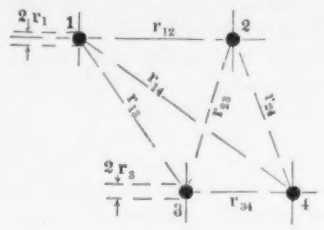


FIG. 2.—TWO METALLIC CIRCUITS.

Considering the presence of a parallel metallic circuit within the field of Fig. 1, if the two wires of the second circuit lie on the same magnetic flux line, it is evident that they will be at the same electric potential, and that there will pass between them none of the magnetic flux lines, due to the circuit whose wires appear in Fig. 1. Therefore, the circuits will be mutually non-inductive and an e.m.f.

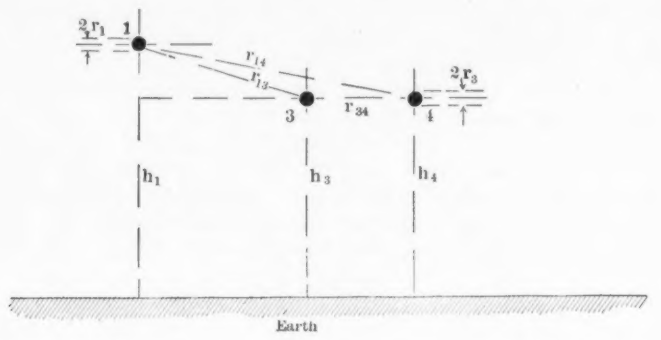


FIG. 3.—ONE METALLIC AND ONE GROUNDED CIRCUIT.

or a current in one will be without effect on the other. When the wires of the two circuits are in any other relation the two wires of the second circuit will experience a difference of potential between them and they will enclose between them part of the magnetic flux, due to the first circuit.

The mutual capacity and the mutual inductance are given for three cases: two metallic circuits, one metallic and one grounded circuit, two grounded circuits. The deduction of these formulæ is based on Heaviside's method in Vols. I and II of his "Electrical Papers," and Heaviside's method is based on Maxwell. The formulæ of the last case are omitted because they may be found in the "Electrical Papers" before mentioned. For two metallic circuits the results are

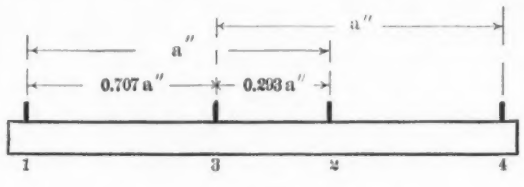


FIG. 4.—FOUR-WIRE POWER LINE.

as given below, with reference to Fig. 2, in which the a wires are 1 and 2, and the b wires are 3 and 4:

$$-C_{ab} = \frac{2\log_{10}\dfrac{r_{14}r_{23}}{r_{13}r_{24}}}{\left(2\log_{10}\dfrac{r_{12}^2}{r_1^2}\right)\left(2\log_{10}\dfrac{r_{34}^2}{r_3^2}\right) - \left(2\log_{10}\dfrac{r_{14}r_{23}}{r_{13}r_{24}}\right)^2} \qquad (3)$$

$$C_a = \frac{2log_{10}\frac{r_{34}^2}{r_3^2}}{\left(2log_{10}\frac{r_{12}^2}{r_1^2}\right)\left(2log_{10}\frac{r_{34}^2}{r_3^2}\right)-\left(2log_{10}\frac{r_{14}r_{23}}{r_{13}r_{24}}\right)^2} \quad (4)$$

$$C_b = \frac{2log_{10}\frac{r_{12}^2}{r_1^2}}{\left(2log_{10}\frac{r_{12}^2}{r_1^2}\right)\left(2log_{10}\frac{r_{34}^2}{r_3^2}\right)-\left(2log_{10}\frac{r_{14}r_{23}}{r_{13}r_{24}}\right)^2} \quad (5)$$

$$M_{ab} = 0.3706\left(2log_{10}\frac{r_{14}r_{23}}{r_{13}r_{24}}\right) \quad (6)$$

In the equations, C_{ab} is the mutual capacity between circuits 1-2 and 3-4, C_a is the capacity of circuit 1-2, C_b is the capacity of circuit 3-4, and M_{ab} is the mutual inductance in mil-henries per mile. To

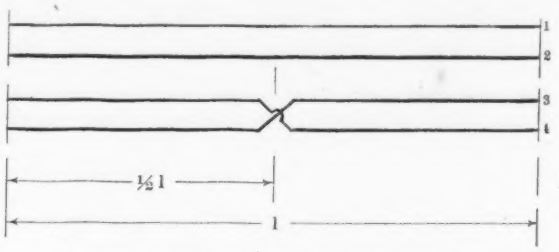


FIG. 5.—DIAGRAM OF TRANSPOSITION.

reduce (3), (4) and (5) to microfarads per mile, the results should be multiplied by 0.07768. The condition of no mutual interference is given in (7).

$$r_{14}r_{23} = r_{13}r_{24} \quad (7)$$

For one metallic and one grounded circuit the results are as follows, reference being made to Fig. 3, in which a, or wire 1, is the grounded circuit and b, or wires 3 and 4, are the metallic circuit:

$$-C_{ab} = \frac{2log_{10}\frac{r_{14}r_{23}}{r_{13}r_{24}}}{\left(2log_{10}\frac{2h_1}{r_1}\right)\left(2log_{10}\frac{r_{34}^2}{r_3^2}\right)-\left(2log_{10}\frac{r_{14}r_{23}}{r_{13}r_{24}}\right)^2} \quad (8)$$

$$C_a = \frac{2log_{10}\frac{r_{34}^2}{r_3^2}}{\left(2log_{10}\frac{2h_1}{r_1}\right)\left(2log_{10}\frac{r_{34}^2}{r_3^2}\right)-\left(2log_{10}\frac{r_{14}r_{23}}{r_{13}r_{24}}\right)^2} \quad (9)$$

$$C_b = \frac{2log_{10}\frac{2h_1}{r_1}}{\left(2log_{10}\frac{2h_1}{r_1}\right)\left(2log_{10}\frac{r_{34}^2}{r_3^2}\right)-\left(2log_{10}\frac{r_{14}r_{23}}{r_{13}r_{24}}\right)^2} \quad (10)$$

$$M_{ab} = 0.3706\left(2log_{10}\frac{r_{14}r_{23}}{r_{13}r_{24}}\right) \quad (11)$$

The notation is the same as previously employed, C_a being the capacity of the grounded circuit and C_b that of the metallic circuit. To reduce (8), (9) and (10) to microfarads per mile, the results should be multiplied by 0.07768. Expression (7) holds for the condition of no mutual interference in this case also, if r_{23} and r_{24} are given their proper values, namely, $r_{23}^2 = r_{13}^2 + 4h_1h_3$ and $r_{24}^2 = r_{14}^2 + 4h_1h_4$. It is interesting to note that there is practically possible an arrangement of two metallic circuits, for no mutual induction from formula (7) and applicable to a four-wire, two-circuit telephone line, or to a two-phase, four-wire power line, as shown in Fig. 4, where 1 and 2 is one circuit and 3 and 4 the second circuit. The induced currents may be arrived at approximately for short lines by the following formulæ:

$$E_b = -M_{ab}\omega I_a \quad (12)$$

$$I_b = -C_{ab}\omega E_a \quad (13)$$

where the subscript a denotes the primary or disturbing circuit and

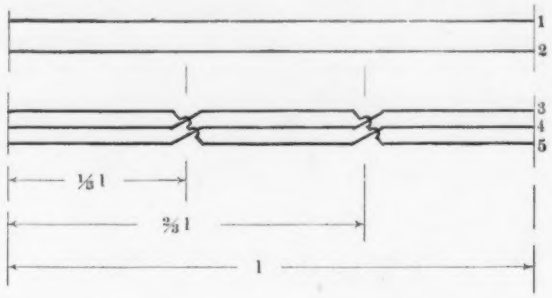


FIG. 6.—METHOD OF TRANSPOSING THREE WIRES.

b the secondary or disturbed circuit; $\omega = 2\pi n$ where n is the frequency. The induced e.m.f. is circuital and the induced current transverse in circuit b.

It is evident from the formulæ for mutual capacity and mutual inductance that interchanging the two wires of a metallic circuit reverses the signs, but not the magnitudes of the constants of mutual interference. Such an interchange of the wires amounts to a rotation of the circuit through 180° and is the definition of a transposition. The effect of a transposition in a given circuit, on an adjacent circuit, is to reverse the direction in the adjacent circuit of the induced e.m.f. and current, with reference to the parts of the adjacent circuit on opposite sides of the transposition. It does not matter in which circuit the transposition is made, but the transposition, at the same point, of both circuits does not change the signs of the constants of mutual interference.

Considering Fig. 5, the presumption is that the e.m.f. and the current in the disturbing circuit are constant in phase and in intensity throughout the distance l. Therefore, l must be short enough so that this is sensibly true; even in this case a slight current will flow toward the terminals, due to the fact that the transverse induced current will not entirely vanish through the transposition, owing to the slight impedance of this short path. Fig 6 shows the method

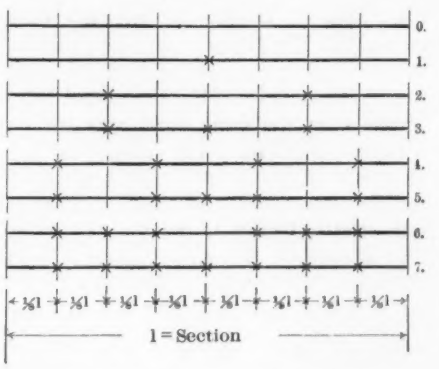


FIG. 7.—EIGHT TYPES OF TRANSPOSITION IN A STANDARD UNIT SECTION.

of transposing a plane circuit of three wires. In general the transposition of an n wire plane circuit will require, in a given section $(n-1)$ transpositions at intervals throughout the section of $1/n$th the total length; if the n wires be uniformly disposed around a circular circumference, each transposition will be a rotation of the circuit of $1/n$th of a revolution, always in the same direction.

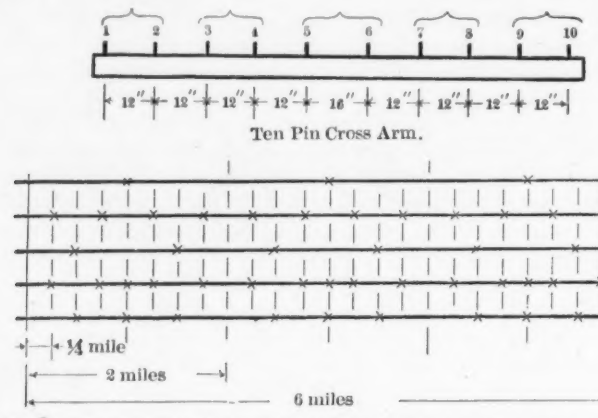
The transposition of telephone lines is treated by means of adopting a unit section, of a few miles in length, within which all the circuits are made mutually non-inductive. The advantage of this is realized in treating heavy complicated lines; a starting point is selected and the transposition section applied consecutively until

reaching some abrupt change in the line where the exposures are altered, and the remaining length of line, if the total length is not an integral multiple of the length of the standard section, is added to the previous section or made a section by itself, extending or shortening the standard section to meet the requirements of the special end section. Fig. 7 shows the manner of developing a system of mutually non-inductive circuits.

Eight types are shown, the simplest type being untransposed and the last, or eighth type, having seven transpositions; a metallic circuit is there represented by a single line. The term "exposure," referring to Fig. 5, is defined as 1/21. Fig. 7A shows the exposures in the following table:

	0	1	2	3	4	5	6	7
0								
1	1/2							
2	1/4	1/4						
3	1/6	1/6	1/6					
4	1/8	1/8	1/8	1/8				
5	1/10	1/10	1/10	1/10	1/10			
6	1/12	1/12	1/12	1/12	1/12	1/12		
7	1/14	1/14	1/14	1/14	1/14	1/14	1/14	

The upper row and the left-hand column refer to the circuit numbers of Fig. 7. Consider, for example, the exposure of No. 0 to No. 6: the second and the fifth transpositions in No. 6 are without sensible effect, if *l* is not great, because a transposition at the junction of two contiguous non-inductive sections is without effect. These two transpositions are necessary, however, when considering the exposure of No. 6 to other of the circuits. The choice of a length for *l* will depend on conditions; it should not exceed ten miles and should not be so short that transpositions will fall within



FIGS. 8 AND 9.—TRANSPOSITION OF TEN-WIRE LINES, USING TWO-MILE SECTIONS.

the line spans. The best standard of exposure in use is one-fourth of a mile between adjacent circuits on the same cross arm; in this case cross talk will be absolutely inapparent under normal conditions. For circuits which are not adjacent the following rule is given: Calculate from equation (6) the mutual inductance between two adjacent circuits on the same cross arm for one-fourth mile; for any other exposure calculate the mutual inductance from (6) for one mile and divide the latter result into the former and the quotient will be the theoretically permissible exposure in miles. It would have been equally logical to use the mutual capacity, but the results would be practically the same, which is explained in detail in the paper. A case of a ten-wire, five-circuit line is worked out on the basis of a quarter mile standard with *l* equal to two miles. The following table gives with reference to Fig. 8, the theoretically permissible exposures of five circuits on a ten-pin arm, based on an exposure of circuit 1 and 2 to circuit 3 and 4 of one-fourth mile, the tabular values being in miles:

	1-2	3-4	5-6	7-8	9-10
1-2					
3-4	0.25				
5-6	0.90	0.21			
7-8	2.85	1.31	0.21		
9-10	4.95	2.85	0.90	0.25	

Fig. 9 illustrates the case of ten wires using two-mile sections. Considerable latitude is possible in applying this method, but the number of transpositions should be kept a minimum. Any discontinuity in the exposures should be made the junction of two contiguous sections; a discontinuity is constituted by a junction at which lines enter or leave the main line, such as junction poles, cable poles or intermediate offices, changes in the distribution of circuits in the line, etc. Cross talk between grounded lines of considerable length will be very serious and there is no cheap practical remedy now available. The use of aerial unsheathed cable represents the worst situation as regards induction; such cables, if of considerable length, should have a grounded sheath. The use of phantom circuits requires transposition of circuits as a whole. For example, if circuits

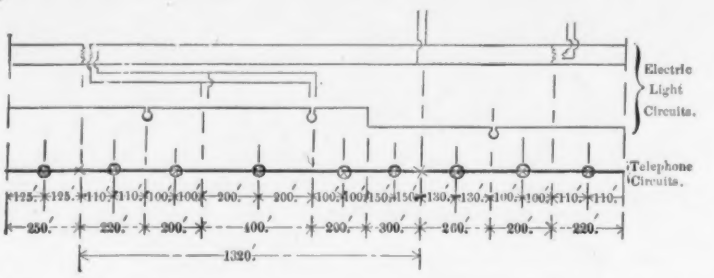


FIG. 10.—TRANSPOSITION IN CASES OF COMPLICATED EXPOSURE TO ELECTRIC LIGHT AND POWER CIRCUITS.

1-2 and 3-4 are employed as a phantom, it is necessary, in transposing, to change wires 1 and 2 to pins 3 and 4, and wires 3 and 4 to pins 1 and 2. Such phantom transpositions will be necessary if two or more phantoms exist on one pole line and a single phantom will not usually be a satisfactory quiet circuit unless transposed.

The transposition of telephone lines to eliminate induction from electric light or power circuits is treated from the standpoint that any point in the exposure where the disturbing e.m.f. or current changes in phase or in intensity should be the junction of two contiguous special transposition sections. Fig. 5 shows the procedure in the simplest case; if circuit 1-2 were bridged by a transformer the procedure would be to divide the total exposure into two sections, each transposed at its middle point, the transformer being at the junction of the two sections. This principle would apply equally if 3-4 were bridged at some intermediate point by a subscriber's loop—as in the case of a party line. The general rule given is: "Treat as one section the distance between two consecutive changes of any character in any of the circuits; transpose all the telephone circuits at the middle of each such section."

Two figures are given in the paper, one representing a case of exposure to constant potential circuits, with the necessary transpositions, and one representing the treatment of constant current exposures. A third figure, Fig. 10, represents both cases combined. Transpositions in the telephone circuits to eliminate cross talk should

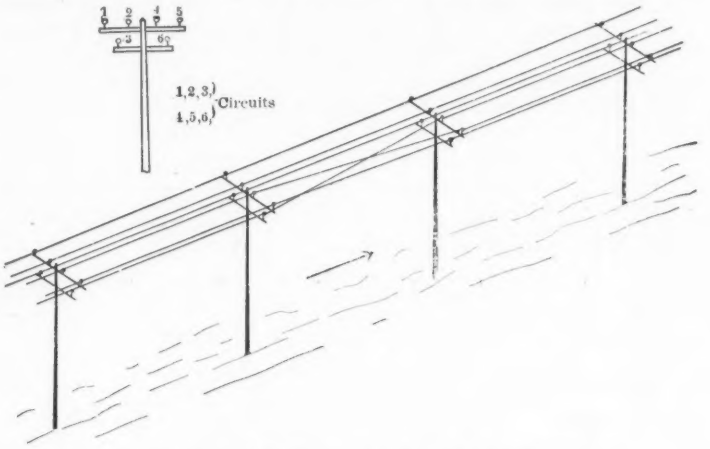


FIG. 11.—TRANSPOSITION OF A THREE-PHASE LINE.

be located at the junctions of sections which are non-inductive with respect to the electric light or power circuits.

The crosses within the circles, in Fig. 10, represent the transpositions to eliminate induction, meaning that all the circuits are transposed, and the plain crosses represent those to eliminate cross talk, meaning regular transposition points of a system. The exposure represented is that due to a constant-potential, single-phase distribution and a constant current arc or incandescent line. It is not general practice to transpose distributing systems, but transpositions in high-tension transmission work are frequently employed. Fig. 6

should be followed in three-wire lines, either single or polyphase. The well-known "spiral" is shown in Fig. 11, which illustrates the transposition of a three-phase line on the basis of a right-hand spiral of one-third revolution.

Another example of transposition is given in Fig. 12 for single-track, long-haul electric railway service: Where wires 1, 2 and 3 transmit power at high tension, three-phase, wire 7 is for the block signal circuit, wire 8 is the feeder and 5-6 the telephone circuit. Apply the method of Fig. 10 in transposing 3-6; treat spirals, feed taps to the trolley wire, signal boxes, turn-outs, junctions and telephone stations as discontinuities in the exposure of 5-6 and transpose midway between two consecutive discontinuities, throughout the exposure.

It is usually preferable, where a telephone line parallels a power line, not to depend on transpositions in the power line, but to consider them as discontinuities in the exposure and to make the telephone line dependent on its own properties only and not partly on those of a foreign system. The disturbances from constant potential power circuits, parallel at distances of 40 or 50 ft., are not usually serious for exposures under one mile, and for longer exposures the

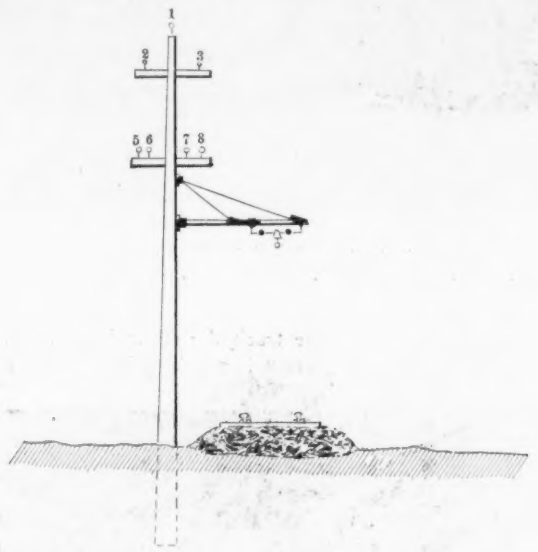


FIG. 12.—TRANSPOSITION FOR SINGLE-TRACK RAILWAY SERVICE.

regular transpositions may suffice. A single-wire, arc light line is the most serious proposition, and if it is close to the telephone line it will cause prohibitive disturbances for exposures upwards of a few hundred feet. When the exposure becomes so complicated that transpositions are necessary every few feet and occur frequently in the spans it is necessary to resort to twisted pair insulated wire, aerial cable or electro-magnetically shielded conductors. Not infrequently the disturbances from a system on which service is given for twenty-four hours a day are noticeable only at night; this is usually conclusive evidence that the disturbance is principally electro-magnetic.

The permissible current in a telephone receiver which will not interfere with received transmission varies with the frequency, the wave form and the sensitiveness of the receiver. The approximate range of this current in commercial receivers is from 5×10^{-5} amp. at low frequencies to 5×10^{-6} amp. at high frequencies, meaning by the latter, 200 or 300 cycles. In this connection it is obvious that receivers of low sensitiveness in conjunction with transmitters of maximum power give the best results.

The joint occupancy of pole lines by telephone, telegraph, fire alarm, power and electric light systems is common in suburbs and residential districts. All wires should be securely tied and insulated at all points and the wires should have a reasonable clearance with reference to trees and all foreign objects. Slack in any of the circuits renders the transpositions, in general, less effective. Poor construction and poor maintenance will vitiate the expected results from a perfect system of transpositions. Leakage may be avoided by good construction and extra stress should be laid on this point. The power and electric light wires should be strung as close together as practicable, in order to reduce the induction, and as far as possible from the telephone circuits.

The lines which are least likely to break or to get into trouble should occupy the highest position on the line. For this reason and the reason that telephone development usually experiences the most rapid growth, the power and electric light lines should usually be above the telephone wires; in the reverse case ample room should be left for telephone linemen to reach their own wires without hazard from the power wires.

Joint occupancy of lines is probably inadvisable when the voltages exceed 5,000, excepting the case of constant-current arc circuits. When the voltage exceeds 10,000 the systems should be on separate pole lines and the minimum distance between the butts of poles should be such that when the highest line falls toward the other line it will completely clear it. Any construction which will permit a high-tension line to become crossed with a telephone or a telegraph line in case of a general break-down is to be condemned. At crossings with high-tension lines the telephone line should cross underneath if possible and the poles should be so arranged that the greatest length of broken wire which can swing downward will clear the lower line; an insulated screen of guard wire should be interposed between the lines. As to the question of adequate protective devices on the telephone lines, it is probably cheaper to eliminate the danger by spending a considerable amount in moving the lines, because no cheap practical protective devices are available.

Recent Electrochemical Developments.

PRODUCTION OF CHROMIUM FROM CHROME-IRON ORE.

A patent was granted on November 10 to Messrs. R. Suchy and H. Specketer, of Griesheim, Germany, for a method of treating chrome-iron ore. It is based on the fact that the chromium can be extracted in a simple manner by treating the chrome-iron ore in hot acid solutions with oxidizing agents, such as peroxide of lead, peroxide of manganese, permanganate, chrome acid, etc. The dissolving action of these oxidizing agents is explained by their turning the protoxide of iron contained in the chrome-iron ore into peroxide of iron, whereby a dissolution is rendered possible.

The operation is carried on as follows: Chrome-iron and about double the quantity of sulphuric acid (of about 50° Baume), which is required for combining with the bases of the ore to form salts, are heated in a suitable vessel, while a quantity of chromic acid extending that required for oxidizing the protoxide of iron or peroxide of iron is added. This excess of acid is not absolutely necessary, but accelerates the reaction. The excess of sulphuric acid forms chromo-sulpho acid from the sulphate of chromium, and thus facilitates the separation of the chromium from the iron. The mixture is heated up to a temperature from 120 to 150° C., the solution going on smoothly and easily. At a temperature of about 150° iron is precipitated as a white sulphate of iron, which is hardly soluble in water, while the sulphate of chromium forms with the excess of sulphuric acid chromo-sulpho acid, and can thus be easily separated from the sulphate of iron by filtration.

So far the process is purely chemical, but an electrochemical method may be made use of to apply a smaller amount of oxidizing agent than is necessary for the dissolution. In this modification of the process a small quantity of sulphate of chromium or sulphate of lead or of another salt capable of undergoing a high degree of oxidation by electrolysis, is added to the sulphuric acid and chrome ore. This mixture is heated while an electric current is passed through it, chromic acid being thereby produced which dissolves the chrome-iron ore while being itself again reduced. By the electrolysis the oxidation is kept going on until the whole quantity of chrome-iron ore is dissolved.

MISCELLANEOUS.

A patent was granted on November 10 to Mr. Charles E. Acker, of Niagara Falls, N. Y., the well-known inventor of the Acker process for the electrolysis of sodium chloride. It relates to the mechanical details of a carbon electrode and conductor, designed particularly for use in electrolytic operations with high current densities and in fused electrolytes. A carbon block constitutes the working head and a carbon "shank" constitutes the conductor and support, removably secured to the carbon block. Provision is made to protect the shank and the junction between the shank and the outside metallic conductor against oxidation from the atmosphere. The lower active surface of the carbon block is corrugated or grooved to permit the ready escape of gases, the grooves being deepened somewhat toward the periphery of the electrode.

Three patents were granted to Messrs. S. Blackmarr and J. L. Willford, of Minneapolis, for a method and apparatus for converting

oxygen into ozone by silent discharge. The method consists in applying the current from the secondary of an induction coil to the opposite sides of a wall of dielectric material, like glass, through wires or coils of wires which are at all points in contact with the wall. Air or oxygen is passed along the wall in proximity to the wires.

A patent was granted to Mr. F. de Mare, of Brussels, for an electric heating apparatus. A thread of carbon is used as resistance wire inside a metallic case which, after having exhausted the air from it, is filled with an atmosphere of a gas or vapor that conducts the heat well and does not attack the hot carbon, such as hydrogen, ammonia, carbonic oxide, silicate of hydrogen, nitrogen, oil gas, acetic ether, acetic acid. The metallic casing is preferably made of copper and blackened to obtain a high conductive power and emission of heat.

A patent was granted to Mr. E. Tweedy, of New York City, for mechanical details of arranging the diaphragm in a double fluid cell.

New Fessenden Wireless Telegraph Patents.

By A. Frederick Collins.

TWO recent patents granted to Prof. Reginald A. Fessenden are divisional reissues of serial No. 177,829 and relates to aerial wires for the propagation of electromagnetic waves in general and to uniformly distributed capacities in particular.

In all other forms of aerial radiators and resonators the coefficients of capacity and inductance are "bunched," and this is one of the fundamental differentiating features of the Fessenden system. The object of uniformly distributing the capacity, which is great when compared with its complementary inductance, is to produce in the first place a more efficient system of radiating aerial wires, and in the second place the translation of electric oscillations set up therein into the alphabetic code used in telegraphy without the intervention of especial wave detectors.

CAGE.

By this method of capacity distribution it has been found by the inventor, according to the text of his patent, No. 12,169, that a much closer approximation to a pure sine wave is obtained on account of fewer harmonics being generated, and in order to fulfil these conditions in a physical way a number of parallel wires are formed into a cylindrical cage, as shown in the diagrammatic drawing. The ends of the radiating wires are supported by a ring made of insulating material. This gives the aerial conductor a low resistance and at the same time a capacity that is large when compared with a single-wire radiator.

By using such a radiator and receiving aerial the second condition is fulfilled, since, as it is stated in Fessenden's patent, No. 12,168, a low frequency is obtained. In the ordinary type of oscillator the frequencies range from 100,000 to several millions per second, sending out waves of proportional length.

Lodge has shown in some of his earlier experiments (1897) that by increasing the value of inductance and capacity of a closed oscillator system the frequency could be slowed down to such an extent that a musical note was emitted. The writer made a series of experiments in 1901, which were published in the *Scientific American*, June 18, 1902, wherein it was shown that by adding capacity and inductance to an open circuit, one terminal of which was connected to earth, the period of oscillation was reduced to a value represented by mechanical vibration; and by this method articulate speech was reproduced in a complementary resonator system. The date of Fessenden's original patent was August 12, 1902.

In the case of Lodge's and the writer's own experiments, the coefficients were "bunched," whereas in the Fessenden patents the capacity is distributed. What is said above is not intended to imply that Prof. Fessenden is claiming letters patent for a wireless telephone system by electromagnetic waves, but merely to show the difference in the conclusions arrived at by Lodge, Fessenden and the writer. The greatest value of the Fessenden method lies in its application to syntonic wireless telegraphy, since a sine wave is after all the vital factor in electrical resonance.

Trackless Trolley Experiments at Scranton, Pa.

Due probably to the fact that the average roads in Europe are so much better than they are in the United States, experiments with what are known as trackless trolleys have been far more frequent and successful there than here. We have noted from time to time in illustrated articles the work that has been done in Germany and

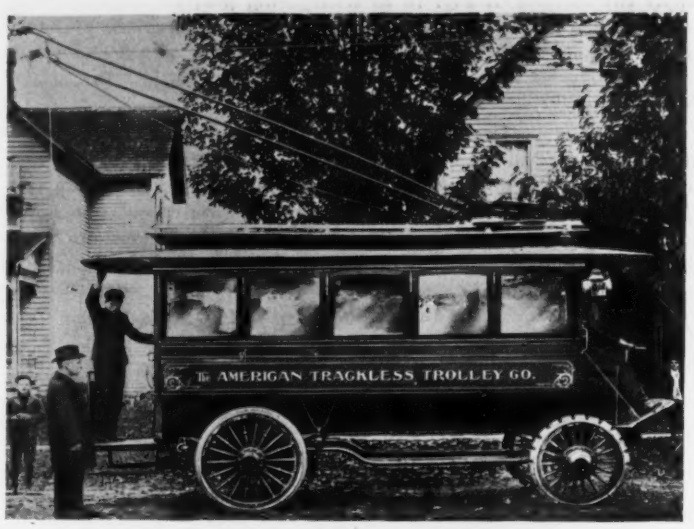


FIG. 1.—TRACKLESS TROLLEY 'BUS.

France with vehicles of this description. It would appear from the data recorded that the results are of an encouraging nature, even although from the absence of the track the effort is so much greater that at least twice as much current is required for the same tractive

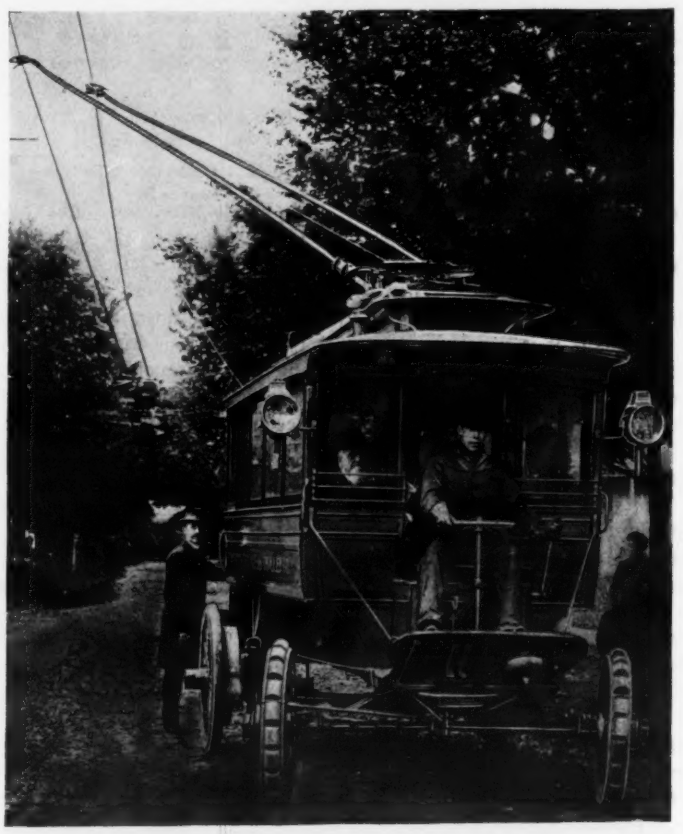


FIG. 2.—FRONT VIEW OF TRACKLESS TROLLEY 'BUS.

effort. We are glad to be able to call attention to an experimental line now being operated in this country at Scranton, Pa. As will be seen from the engravings in Figs. 1 and 2, the vehicle is practically an omnibus of the automobile type having a trolley car platform with step at the rear, and a seat in front for the motorman with steering gear, controller, brake mechanism, etc. The under-running framework of tubular steel carries an automobile motor which need not be here described as it is proposed to make changes and improve-

ments in this particular respect. The interest centers chiefly in the overhead construction, which of course is of a double trolley type, as shown in the detail diagrams. The trolley allows the coach to turn out a distance of 15 ft. to either side of the road and thus permits the driver to handle his vehicle just as readily as though it were entirely free and unattached.

The system shown is not only adapted to two wires but three wires. In the latter arrangement the center, or third wire, serves as the common feed wire, the two outside wires being the return circuit. With the three-wire system no switches are necessary at the line terminals where loops are arranged for that purpose, but with the two-wire system a switch is located at the entrance of the loop at

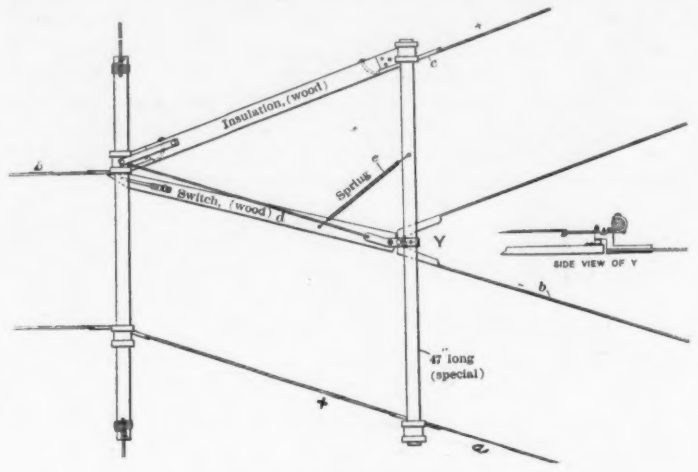
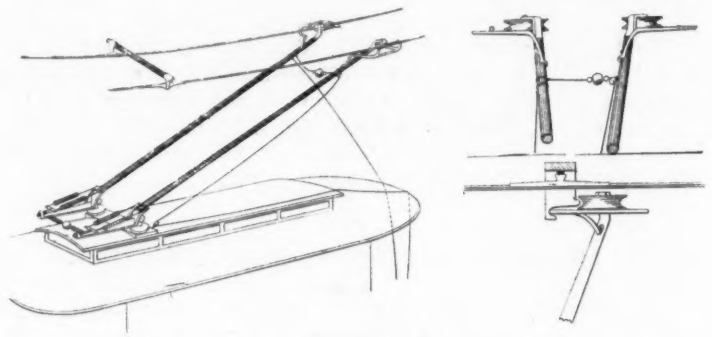


FIG. 3.—OVERHEAD SWITCH.

each end of the line, as shown in the diagram, Fig. 3. The feed wire is carried around the loop to *c*, where it is insulated from the return wire, *b*. When the trolley wheel reaches the wooden track or switching piece, *d*, it is thrown over to the wire, *a*, returning to its original position under the influence of the spring, *e*. Fig. 4 shows the two-wire track and the trolleys in contact therewith, while Figs. 5 and 6 show the trolleys themselves as well as the method of guiding the trolley wheel across gaps. The overhead system appears readily adaptable to sharp curves and even to passing regular trolley lines,



FIGS. 4, 5 AND 6.—DETAILS OF TROLLEY.

while of course spurs can be extended to car barns, passenger depots and freight houses.

As to the cost of the system, the installation of trolley wires and supports is put at $1,600 per mile, while the cost of a coach carrying 20 passengers seated and 15 standing, with full equipment of motors and trolleys, is put at $2,600 each. The installation at Scranton was made by Mr. F. G. Tilton, of the American Trackless Trolley Company, of Boston, whose president, Mr. A. B. Upham, is the inventor of the system.

Non-Interfering Wireless Telegraphy.

A cable dispatch from Rome Nov. 14 says: "The naval authorities have been experimenting with the Artons system of radiotelegraphy. It is said that the experiments have conclusively proved that messages transmitted by this system in a given direction can only be received at the station to which they are sent."

New Telephone Patents.

A NEW TRANSMITTER MODIFICATION.

The last patent issue brings forth a novel transmitter modification. This is the invention of Alfred Stromberg, of Chicago, who naturally assigns his patent to the Stromberg-Carlson Company. The novelty in this transmitter lies in the mounting of the carbon granule case within a central opening of the diaphragm instead of the now common practice of using a threaded stud for uniting the electrodes and diaphragm. Fig. 1 shows a sectional view of the working parts of the transmitter, which has many of its details evidently founded upon those of the solid-back transmitter, for many years so successful. The assembly of parts is, however, quite different, for the granular button is turned end for end, the usual back electrode and carbon retaining box moving with the diaphragm; while the other electrode is rigidly secured to the bridge. An annular mica disc forms the flexible connection between the stationary electrode and the granule box, while annular clamping nuts upon the threaded exterior of the box serve to form a semi-flexible connection between the diaphragm and box.

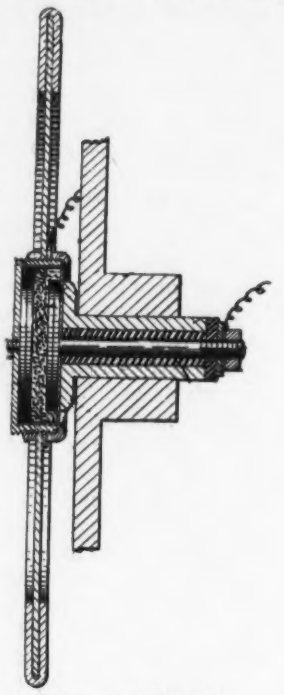


FIG. 1.—STROMBERG TRANSMITTER.

TWO SUB-STATION CIRCUITS.

One of our contemporary journals, a short time ago, in answer to an inquiry of a correspondent concerning so-called "anti-side-tone," or low side-tone circuits, stated that no such arrangement of circuit was in existence. As a matter of fact, a great deal of work has been done to develop such a circuit; and for a year or two past the operators' circuits of a number of large central offices have been provided with induction coils almost eliminating side-tone. A few months ago we noted in these columns a patent for a subscriber's station circuit, the principal object of which circuit was the cutting down of side-tone. This week we have at hand for consideration another such circuit. This latter is the subject of a patent granted to George K. Thompson, of Newton, Mass., and assigned to the American Telephone & Telegraph Company. This new circuit is shown at the left of Fig. 2, from which it is seen that a three-part induction coil is used. The secondaries each cover one-half the length of the core, while the primary extends from end to end. By this arrangement and a suitable poling of the coils a

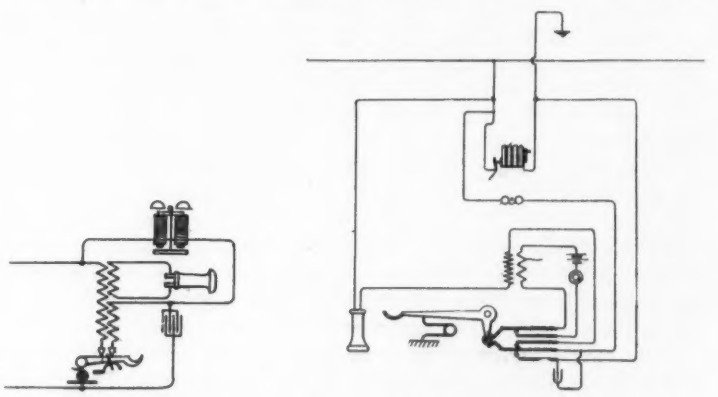


FIG. 2.—THOMPSON TELEPHONE CIRCUITS AND APPARATUS.

minimum of mutual induction may be made to take place between the two secondaries, while the primary has a maximum of inductive effect on both secondaries. A further examination of the circuit shows that one secondary with the receiver forms a local circuit, while except for this removal of the receiver from it the remainder of the circuit is the American Bell standard. The coil as used is wound with No. 26 wire in the primary to thirty ohms, and with No. 31 wire in the secondaries each to twenty-six ohms, the receiver being seventy-five ohms and the condenser two microfarads. To

all who have experimented with sub-station circuits, the reason for the present wiring of parts will be evident, it being well proven that a receiver connected in local circuit, as shown, gets little side tone, while the retention of a secondary linked with the primary and transmitter retains all the efficiency of transmission of the present standard Bell circuits.

Another new sub-station circuit is that shown at the right of Fig. 2. This is a magneto system circuit, and the main object in view is to interpose a condenser in the receiver circuit, and thus raise the impedance of that circuit to such an extent that the presence of a receiver across the line due to the carelessness of some subscriber will not cause the failure of the bells. The peculiar construction of the hook switch with contacts to normally short circuit the condenser is made to protect the latter from puncture by lightning. This circuit is the property of the Stromberg-Carlson Company, who have obtained the patent by assignment from the inventor, Garrison Babcock, of Chicago.

NEW EXCHANGE CIRCUITS.

This issue of patents brings to light three common battery exchange circuits, two for manual switchboards and one automatic. One of these, invented by W. A. Taylor, of Chicago, and assigned to the Kellogg Switchboard & Supply Company, is almost identical with a system recently patented by Mr. K. B. Miller, and described a week or two ago. This is a system employing two-strand connecting cords and using repeating coils to connect inductively the circuits of the two cords of a pair. Mr. Miller's circuit was rendered of questionable value by the use of plug socket switches to control his supervisory signal circuits. In the present system the use of these plug socket switches has been obviated by inserting a condenser in the middle of each side of the repeating coil, the windings being split to allow of this arrangement.

The second manual board circuit also requires but two strands in the connecting cords, but in so far as shown in the patent no "busy test" is provided. Double-lamp supervision is, however, accomplished, the lamp being shunted out by the supervisory relays exactly as in the standard switchboards of the Bell companies. Cut-off jacks supersede the cut-off relay, and that part of the supervisory lamp circuit usually controlled through this latter and the connecting cords is transferred to an auxiliary locking relay whose contact and coil are in series. Normally this relay is re-energized, but if the ringing key be thrown an auxiliary contact in this key closes the relay circuit until such time as the relay armature can come up and thus cause the relay to hold its circuit closed. The operator's listening key also has an auxiliary contact which is opened whenever this key is thrown. This contact is also associated with the auxiliary relay circuit, being in it in series. When a conversation is complete and both supervisory lamps are bright the auxiliary relay must be unlocked to dim them. This is, of course, accomplished by momentarily throwing the listening key and breaking the auxiliary relay circuit until the armature can fall back and open its contact. G. L. Cragg is the patentee of this system, having assigned his patent to the Stromberg-Carlson Company.

The automatic system at hand for consideration is the joint work of Messrs. M. C. Rorty and A. M. Bullard. It is quite different in detail from the automatic system of these same inventors described in these columns a year ago, yet it accomplishes exactly the same results, providing not only for connection of subscribers, but for automatic ringing and busy signals as well as for secrecy. The junctions of the various parts and circuits are quite similar to those of the earlier patent in connection with which they were described at length. It does not, therefore, seem advisable to go into great detail here. Suffice it to say, that the switching member, in making a call, travels vertically in front of and some distance away from the multiple line contacts until over the one desired. This vertical movement takes place in response to the subscriber's selective switch. When the receiver of the calling party is removed from the switch hook, the metallic circuit being completed, the central office switch contact is thrown into contact with the desired subscriber's terminal and line if he be not busy. His bell is then rung. If he be busy, a busy signal or hum is returned to the caller.

A RINGING DEVICE.

A rather novel ringing device is that included in a patent for a telephone exchange system just issued to J. C. F. Multhauer, of Minneapolis. This device renders the use of a steady source of ringing current unnecessary by bringing a pole changer within the connecting cord circuits in such a way that the generation of alternating current is controlled directly by the ringing keys. The circuit is well shown in Fig. 3, wherein a pair of connecting cords is drawn completing a connection between two subscribers' lines. One coil of the transformer, 21, is connected to the ringing keys, while the other two coils are so associated with the ringing battery, 25, the pole changer, 29, and the wiring, that the depression of the ringing key closes the vibrator circuit, causing the generation of the ringing current. The circuit for the first primary current impulse is from

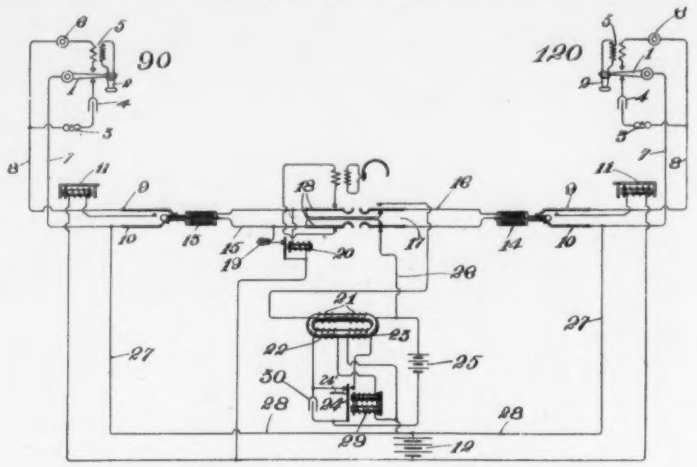


FIG. 3.—MULTHAUER TELEPHONE SYSTEM.

25 through armature 24, coil 22, winding 29, wires 28 and 10 and key 17, back to battery 25, whereupon the armature, 24, makes its forward movement to the front contact. This establishes the reverse circuit through coil 23, which may be similarly traced. The Stromberg-Carlson Company has also obtained this patent.

SELECTIVE SYSTEM.

Another signalling patent is that granted to Messrs. C. M. Jacobs and A. H. Nicholson, of England. This provides for the selection at will of any of twelve subscribers' stations on a party line by the use of polarized relays and the various possible combinations of direct currents and the two line wires and earth. In fact, the only difference between this and the well-known B.W.C. system seems to lie in the association of a separate relay with each of the three fundamental circuits instead of combining these in one or two compound-wound relays as in the earlier system.

A REPEATER AND AN ANTISEPTIC DEVICE.

The last two patents for consideration show "old friends in new garb," covering respectively a telephone-microphone repeater, using a compound or three-section induction coil and a sheet-of-paper type sanitary device. For details the reader, if interested, is referred to the patents, granted respectively to G. E. Sundquist, of Cleveland, and Abraham Levi, of Baltimore.

Meeting of Philadelphia Institute Chapter.

A meeting of the Philadelphia Branch of the American Institute of Electrical Engineers was held Tuesday evening, November 10 at the Engineers' Club. A business meeting preceded the reading of the papers, during which a set of by-laws were adopted and new officers elected as follows: Chairman, Mr. Charles E. Hewitt; secretary-treasurer, Mr. H. F. Sanville. Managers—Messrs. W. C. L. Eglin, Horatio A. Foster, J. Franklin Stevens, W. L. Hodges, G. W. Pike, A. J. Rowland.

Mr. C. B. Voynow, assistant engineer of the Philadelphia Rapid Transit Company, presented a paper on "A Method of Track Laying and Bonding." The paper was very instructive and interesting, describing as it did the Nichols-Voynow rail joint, which is in use throughout Philadelphia, and which is a new departure in methods of track laying. There was a spirited discussion in which Messrs. Pike, Hering, Hodges and Hewitt took part.

Mr. Horatio A. Foster gave to the meeting reminiscences of his experiences in the early eighties, when installing and trying to operate the first electric railway in the city of Baltimore, for the old Daft Company. The talk was very interesting, and, in the light of modern practice, decidedly humorous.

Mr. Charles E. Hewitt, with the assistance of some lantern slides, showed the development of the railway motor from its beginning to the present time.

The Albert & J. M. Anderson Manufacturing Company sent for exhibition at the meeting its collection of relics of early practice in overhead construction. Some of these were very interesting, and, placed alongside of the elaborate new devices, which were also on exhibition, told better than words of the enormous development in electric traction in the last twenty years.

The Chatel St. Denis-Palezieux Railway.

The latest Swiss railway is a line recently opened which serves to connect the trunk line, known as Jura-Simplon, at Palezieux, with the small city of Châtel St. Denis.

The track is one metre gauge and the line has grades of a maximum of 3.2 per cent. Electrical energy is brought from the hydro-electric plant of Châtel St. Denis by the holder of the concession, and the current, which is received at 4,000 volts, three-phase, is transformed to 750 volts in a sub-station situated at St. Denis. The transformation is made by means of motor-generators, the motors

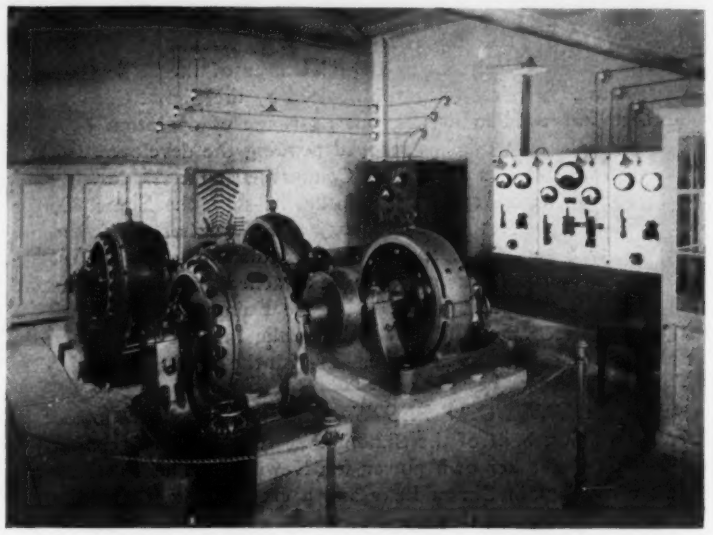


FIG. I.—MOTOR-GENERATORS, SWITCHBOARD, ETC.

of which are of the asynchronous or induction type wound for 4,000 volts, 50 cycles, three-phase. The frequency of 50 cycles has been somewhat a determinative factor in the choice of motor-generators instead of rotary converters. There are, however, some examples of rotary converter stations operating at a frequency of 50 cycles in the same district.

The power generated by the motor-generators is 53 kw under 750

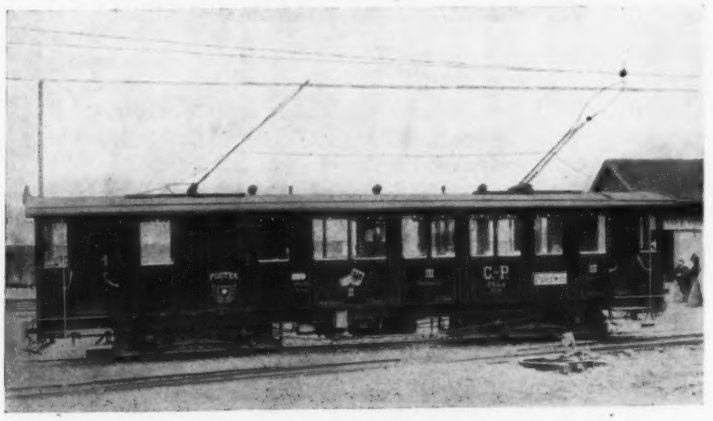


FIG. 2.—TYPICAL CAR.

volts. Multipolar dynamos connected to the induction motor are shown on the illustration. Near the motor is to be seen the three-phase starting resistances. It connects by three wires to the three brushes resting on the armature rings of the motor. When after starting the resistance has been gradually lowered by the rheostat and short-circuited, a final short-circuit is substituted on the armature itself directly by means of brushes, the operating rod through the end of the shaft being clearly illustrated. The brushes are finally removed from the rings by an arrangement for that purpose. The switchboard is fitted with Hartmann & Braun instruments, which are much used on the continent. The direct-current apparatus is shown on the right and the alternating current on the left hand.

A storage battery works as a buffer battery in parallel with the machines and is charged by means of a booster, which permits of the pressure being raised as high as 1,000 volts. The traction line is operated at 750 volts and current is collected by the cars by means of two bows as represented in the accompanying illustration.

The cars, which are each supplied with a 30-hp motor, are mixed cars of second and third class, having eight seats for second and 30 for third-class passengers. There is also a baggage compartment. The maximum speed of the trains approaches 24 miles an hour. Good operation has been the rule throughout, due to the good management and excellence of material and rolling stock. The builders of the latter are Messrs. Alioth et Cie, of Bâle.

A Riedler Steam Turbine.

Prof. A. Riedler, the well-known mechanical engineer of Berlin, Germany, gave recently a lecture on steam turbines before the Österr. Ing. Arch. Ver., in Vienna, Austria. The paper contained some highly interesting details upon the new turbine developed by Riedler in connection with Prof. Stumpf and built by the General Electric Company, of Berlin.

The new turbine is in action and type similar to the turbine of De Laval. There is a series of blades cut in a solid steel disc by special cutters, which finish a wheel per day. The diameter of the disc is approximately 3 metres—smaller, for higher speeds, and larger if lower speeds are desired. The De Laval turbine has, according to Riedler, several drawbacks, which are avoided in the new type. There are not merely a few nozzles of elliptical section, but a whole belt of nozzles is formed, and by means of the closed steam belt the "resistance of ventilation" is reduced to zero. The friction between the disc and the steam is negligible, when the disc is well polished. For instance, the disc of a 2,000-kw Stumpf-Riedler turbine running in steam did not come to rest until after two hours. The principal source of loss in steam turbines is the resistance of ventilation produced by buckets running empty. This loss may be avoided in applying a closed steam belt, which is produced by nozzles of quadratic section partly superposed. The buckets of the Riedler turbine resemble those of the well-known Pelton type. The steam jet is divided by a central "slipper" in two parts. The Riedler turbine is much simpler in construction than other steam turbines, including the Parsons and Curtis types. There are only two parts: a solid steel disc running at a peripheral velocity of 340 metres per second and a fixed nozzle ring connected with the case. At this extraordinary high velocity the disc is not overstrained, but a factor of security = 5 is obtained. The form of the buckets and nozzles has been chosen after careful experiments. In this special form the effect of the centrifugal force of the mass of the steam, which produces differences in pressure of 0.1 — 0.2 kg. per sq. cm., has been taken into account. The diameter of the slots of a 2,000-kw turbine is so small compared with the corresponding dynamo shaft that the turbine disc may be disposed flying; that is, with only one bearing. The air-gap is 3 mm. That is much higher than the air-gaps common with Parsons and Curtis turbines. The oil consumption is extremely low. It was impossible to detect any oil consumption after a two months' operation of a 200-kw turbine. Of course, there is only one bearing to lubricate. The steam consumption is dependent of the size of the turbine. The first turbine showed a consumption of 14 kg. per brake hp, working without condensation. The 200-kw turbine gave a consumption of 6.7 kilos per brake hp, and the 2,000-kw turbine a consumption of 7.6 kilos per kilowatt. In fact, the turbine has the same efficiency as the very best reciprocating engines. As to cost, Riedler estimated that of smaller turbines at ⅓ to ⅙ of the cost of a piston engine of the same output. With turbines of large sizes, this figure is reduced to 1/10. The 2,000-kw turbine was not anchored with bolts, but stood immediately on the floor. Riedler has also developed entirely new types of compressors, condensers and pumps for direct coupling with steam turbines of 3,000 r.p.m. and more. He also has designed new means for the regulation of speed and reversing of turbines.

Power Transmission in Washington State.

The longest transmission line in the Northwest is that of the Washington Water Power Company, of Spokane. The line is about 110 miles long all told, between generator and consumer of current. A portion of it runs through swampy country where considerable trouble was experienced last winter on account of ice forming around the pole butt and finally lifting the pole out of the hole. This difficulty was overcome by putting horizontal cross pieces on the butts underground. The line consists of three No. 2 solid copper wires, with 60,000-volt Locke insulators and pins, made of about three-inch wrought iron with cast-iron shanks.

At the generating plant two 2,250-kw, 4,000-volt, revolving-field alternators, each direct-connected to a Victor turbine, operating under a head of 70 ft., have been installed. The electrical apparatus, including generators, transformers, switches, lightning arresters, etc., was built by the General Electric Company. The switchboards are installed on a gallery overlooking the whole power house and all main bus-bars are in separate pottery cells under the gallery. Two sets of bars permit the city service and the transmission system to be separated when necessary. The generator switches are of the motor-operated, remote-control type. The exciter is direct-connected to a separate water wheel without governor. A Lombard governor is installed to operate each of the larger generators; only one of these governors, however, will be used at a time, as a practically constant gate opening on one wheel will be used, allowing the governor on another wheel to regulate for the whole station. Three water-cooled transformers (with one spare) step the voltage up from 4,000 to either 45,000 or 60,000 volts, the latter having been in experimental use successfully on the line for some time. There are no high-tension switches other than disconnecting switches installed between the line and the transformer primaries. Lightning arresters are installed, each single-pole arrester being in a separate brick compartment extending from the lower floor of the building to the high-tension wires.

Current is delivered to six sub-stations, each equipped with three-phase, step-down, water-cooled transformers, varying from 100 kw to 750 kw, with primary taps for 60,000 or 40,000 volts. Each sub-station is equipped with an automatic high-tension oil switch mounted in a separate brick cell above the panel and connected between the transformer primary and line. The current will be used almost exclusively for mining purposes. At the Standard and Hecla mines four General Electric, 300-hp induction motors will be used to drive compressors, hoists, etc. One of these motors will be geared direct to a hoist. There is upwards of 800 hp in synchronous motors and the remainder is in induction motors. The synchronous motors are started direct from the line through low-voltage taps on the transformers.

Electricity at the National Capital.

Mr. Walter C. Allen, the District electrical engineer, has filed with the Commissioners of the District of Columbia his report regarding the operations of his department for the fiscal year ended June 30. The work of changing the system of arc lighting from the old open series lamps to enclosed has been completed. The number of such lamps in operation at the close of the year was 584 enclosed series lamps and 381 enclosed multiple lamps. The service has been greatly improved by this change. Mr. Allen states that three signal circuits were added to the 21 in service on July 1, 1902. Fifty fire alarm boxes were purchased with the special appropriation made for that purpose, and 24 of them placed in service. Eight fire alarm boxes were purchased and installed at cost for private parties. The electric wiring and devices in each of the seven theatres were inspected during the summer.

Tree Felling by Electricity.

The strenuous exertions of President Roosevelt with the axe in tree felling are no longer necessary. M. R. Guenther, United States Consul General at Frankfort, Germany, hears that successful experiments have been made in various forests of France in cutting trees by means of electricity. A platinum wire is heated to a white heat by an electric current and used like a saw. In this manner the tree is felled much easier and quicker than in the old way; no sawdust is produced, and the slight carbonization caused by the hot wire acts as a preservative of the wood. The new method is said to require only one-eighth of the time consumed by the old sawing process.

CURRENT NEWS AND NOTES.

A DREARY SPOT.—A Canadian correspondent informs us that a Dominion Government steamer has just taken to Belle Isle some insulated copper wire for the purpose of establishing telephonic communication between the two ends of that island. The land is nothing but a mass of rock partially covered with moss and producing no wood of any kind. As there are no poles upon which to string the wire, and the character of the land precludes the possibility of erecting them, the wire will be laid along the surface of the rocks.

FAROE ISLAND LIGHTING.—It is suggested that Thorshavn, in the Faroe Islands, should be provided with electric lights. The water power is abundant for nine months of the year and during that period it is so dark that artificial light is necessary. Petroleum lamps are generally used in the shops and houses and for street lighting; this could all be advantageously replaced by electric lighting during the season that lights are most needed. During the months of May, June and July, when the streams are the lowest, no lights would be needed, as it is daylight constantly.

WIRELESS TELEGRAPHY IN THE ARMY.—In his annual report, General Greely, Chief Signal Officer of the Army, says that the system of wireless telegraph devised by the Signal Corps in 1899 has been improved in details, but its range of operation is limited, and experimental work has stopped pending the development of this science by experts in civil life. Commercial concerns having failed to install a wireless system in Alaska, he says, the Signal Corps is engaged in an effort to install a system that shall work from St. Michael to Safety Harbor, near Nome, a distance of 105 miles. The connection by submarine cable of the detached system in southeastern Alaska, of 1,400 miles, with that of the Yukon district, 1,619 miles, is strongly recommended as in the public interests, not only as of strategic value, but also in connection with the development of Alaska.

SUBMARINE BOAT TESTS.—The submarine torpedo boat *Protector,* the first built of the Simon Lake type, left Bridgeport, Conn., last week under her own power for Newport. The *Protector* is in charge of Captain Simon Lake and a crew of six, in readiness for the competitive trial this week between herself and the *Fulton,* constructed by the Holland Torpedo Boat Company. The tests will take more than a week, and the weather conditions may continue the trials still longer. The tests will be conducted by a trial board of naval officers. The tests will be really for supremacy as to which type will be selected by the United States Navy. The tests will include three speed trials over a mile course, light, awash and in a submerged condition, manœuvering ability, speed of diving, torpedo firing, radius of service under the boat's own power, habitability and seaworthiness. There is patent litigation between the two interests.

WHY STRIKES HAPPEN.—An interesting article in the *New York Sun* tells for what trivial reasons strikes are sometimes called. A dispute running over several years and resulting in many strikes took place between the Electrical Workers' Union and the Elevator Constructors' Union as to which should do the electric wiring in elevators. Both unions were in the Board of Delegates. The Elevator Constructors refused to arbitrate and were suspended by the board. The matter was finally referred to an unofficial umpire, who decided in favor of the Electrical Workers. The Elevator Constructors then applied for and got reinstatement in the board. At present the members of a special arbitration committee appointed by the Building Trades Employers' Association are trying to solve the problem whether the Bricklayers or Electrical Workers shall punch the holes in the walls of buildings through which electric wires are to pass. The committee has had several meetings and heard enough evidence to fill a big volume. Hitherto bricklayers have punched the holes, with the result that every year the Electrical Workers have been ordering strikes whenever a walking delegate found a bricklayer punching a hole. The Electrical Workers' Union ran a series of strikes some years ago against the Gas and Electrical Fixtures Union over which union should run the electric wires through gas fixtures. The matter was finally left to an umpire, who decided in favor of the Electrical Workers' Union. The defeated union was placed at such a disadvantage by this decision that it disbanded and its members joined the Electrical Workers' Union.

TOOL BUILDERS' ASSOCIATION.—A very successful and representative meeting of machine tool builders was held in this city last week on the occasion of the second annual convention of the National Machine Tool Builders' Association. The leading concerns were thoroughly well represented and the proceedings were of a most interesting character. As bearing upon the present feeling of depression in the country due to the recent slumps in Wall Street, it may be noted that the association adopted a resolution for the maintenance of prices, declaring that there is nothing in existing conditions to warrant a reduction and resolving to maintain the preset schedule of prices on all machine tools. Mr. William Lodge, of the Lodge-Shipley Machine Tool Company, Cincinnati, Ohio, was elected president; Mr. W. P. Davis, of the firm of that name, Rochester, N. Y., first vice-president; F. E. Reed, of the firm of that name, Worcester, Mass., second vice-president; Enoch Earle, of P. Blaisdell & Co., Worcester, Mass., treasurer, and Mr. P. E. Montanus, of the Springfield (Ohio) Machine Tool Company, secretary. The next annual convention is to be held in Cincinnati.

WIRELESS FOR CATCHING SMUGGLERS.—It is said that for thirty years Puget Sound has been the seat of the greatest opium and Chinese smuggling operations in the country, and the government has spent hundreds of thousands of dollars in attempting to stop smugglers from racing across the Straits of Fucia in small sloops from Victoria or other British Columbia ports with opium and contraband Chinese. They have every opportunity to escape among dozens of islands, and an immense fleet of revenue cutters would be necessary to thoroughly patrol every passage and island coast. The problem of stopping smuggling is now to be dealt with by means of wireless telegraphy. The revenue cutter *Grant* has been fitted with receiving apparatus enabling her to communicate regularly with the wireless telegraph station at Port Townsend. Numerous other stations are to be established at strategic points where operations of smugglers can be reported. The *Grant* and other cutters will thus be enabled to go quickly to the scene of action whenever a suspicious sloop is reported. Captain Tozier, who has chased smugglers for years, declared wireless telegraphy will stop smuggling.

WORDS OF LIFE.—The following, purporting to come from Honolulu, Hawaii, is too good to be wasted in obscurity: "News of an ingenious escape from drowning comes from the Midway cable station. S. McMichael, one of the operators, left Honolulu on the schooner *Julia E. Whale*, for Midway station. The schooner encountered bad weather off the island and was driven on the reef last Wednesday night, October 21. Fears for the safety of all on board were entertained. With remarkable presence of mind, McMichael is reported to have devised a novel life belt. Cylinder records for a phonograph had been placed in his care for the station. When he found the vessel pounding on the reef and likely to go pieces McMichael thought of the records. He plugged up the ends of the cylinders, making them completely air-tight. Stringing them on ropes, he constructed several life belts. He took to the water and floated ashore with the aid of the belts. The remainder of the crew would have been glad of the opportunity to have had similar life belts, but McMichael had used up all of the records. Members of the crew finally were saved by getting their lifeboat launched before the vessel broke up." This is certainly a record-breaker, but it is not explained how the fragile records did not break, nor how they were air-tight, while strung on ropes.

COMPENSATING SYSTEM.—A patent has been secured by Mr. E. E. F. Creighton on a compensating system for alternating-current generators in which means are supplied to increase the voltage of the generator when the current lags due to the presence of an inductive load or when the current increases in the circuit. In these systems it has been proposed to provide a local circuit in which a current is produced bearing a substantially constant volume relation to the current in the main circuit produced by the generator. The current in this local circuit is an alternating current, and means have been provided or suggested to cause this alternating current to act directly or indirectly upon a magnet, such magnet being connected and arranged so that its magnetism affects the voltage of the main circuit. The lag is compensated for by providing a switch or commutator that will divide each cycle of the current in the local circuit in such a way that the magnet winding will receive a nearly equal volume of current in each direction when no lag is on the line, while the presence of a lag automatically provides an excess of current in one direction over that of the other, producing magnetism in said magnet and increasing the voltage of the main line. The greater the lag the greater this excess. Hitherto it has either been necessary to provide a commutator, which gives considerable trouble, or it has been necessary to utilize only half the current produced in the local circuit. It is one of the objects of the present invention to utilize all of the current of the local circuit and yet avoid commutation of such current, thus eliminating the commutator and its troubles. To this end Mr. Creighton provides a switch, which shifts the current in the local circuit periodically first into one and then into another branch circuit or sub-circuit. These sub-circuits comprise the two ends of an energizing coil, or, in other words, two energizing coils, and the switch directs the current of the local circuit alternately into these two coils and in relatively opposite directions therethrough. We thus have what may be broadly referred to as a "magnetism" commutator rather than an "electrical" commutator. By the provision of this apparatus operating on this principle the apparatus of compensating systems and their operation is made more efficient and certain and more regulatable. A further improvement is to shunt the switch referred to, as well as the magnet coils, with one or more condensers, thus obviating the sparking and the inductive effects on the magnet windings and also increasing the efficiency of the system. Mr. Creighton has also in developing his method for a three-phase system provided a novel switch, combining in one structure of a simple character the switching mechanism for all three phases and obviating the necessity of supplying three separate switches. Another patent deals with the method and the adjustment of the elements.

REVERSE-CURRENT INDICATOR.—A patent has been issued to Mr. Leonard Andrews, of Hastings, England, for a new reverse-current indicator for alternating current. An apparatus according thereto comprises a transformer core forming two magnetic circuits magnetically connected together, two secondaries arranged to be energized by said two circuits, respectively, a primary arranged to produce fluxes in both of said circuits simultaneously, and a primary arranged to influence said fluxes, so as to oppose one and assist the other. The circuits of the two secondaries may be either provided with means for producing separate indications or be adapted to produce a single indication resulting from their mutual co-operation. The transformer has a core with a central member which carries one primary winding and which has at its ends two cross members which extend in opposite directions from the central member and are magnetically connected together at their ends and of which one carries equally on its parts projecting on opposite sides of the central member a winding for the other primary, while the other cross member carries the two secondaries disposed one on each side of the central member. Such a transformer comprises two magnetic circuits united for a portion of their length and adapted to be mutually energized by the primary winding surrounding their united portions and other windings, of which one (a primary) is divided between and adapted to influence the two magnetic circuits on their ununited portions, while the remaining windings are respectively located upon the ununited portions of the two magnetic circuits and adapted to supply indicating currents. It will be clear from this that the conductors on the ununited portions of the magnetic circuits may be severally located in any desired positions and are not restricted to the positions previously indicated. The directions and situations of the windings are such that one of the primaries will tend to induce in the two magnetic circuits fluxes to produce equal indicating currents in the conductors therefor, while the other primary will tend to increase the flux in one magnetic circuit and decrease it in the other, the magnetic circuit having the greater flux and producing the controlling or the greater indicating current being liable to change with change in the relative directions of the currents in the primaries. The indications are furnished in various ways. According to one arrangement separate windings are connected to lamps colored red and green, respectively, the arrangement being such that unless currents flow in both of the primaries neither of the lamps will be lighted; but that if currents flow in both in the proper relative directions the green lamp will light, while if one of them flows in the wrong direction in relation to the other then the red lamp will become luminous. It is obvious that the only function of the lamps is to indicate the presence of current in the secondaries, and that consequently any well-known electroresponsive device, such as a voltmeter, may be substituted for the lamps.

BEDS TO BREAK A FALL.—In St. Louis recently a repair lineman working on an alternating-current circuit received a bad shock and became unconscious on a cross arm. Merchants along the street, seeing his predicament, brought out mattresses, etc., and piled them up underneath him so as to break his fall. He was, however, carried to the ground in safety.

RAILWAY SIGNAL APPARATUS.—To dispense with pneumatic and electric motor railway signals, Mr. Clyde J. Coleman, of New York, has just patented a system wherein a supply of liquefied gas is depended upon to furnish the means to operate the signals, in combination with electrical circuits. Carbonic acid gas is specifically referred to in the claims which number no fewer than 112. It is stated that a portable storage tank containing fifty pounds avoirdupois of such gas is capable of operating an ordinary semaphore signal over 12,000 times. Great economy of installation, maintenance and operation is predicated on the new deparature.

COATING GLASS GLOBES.—Mr. Henry Keppler, of Brooklyn, N. Y., has patented what seems to be a simple system of coating bulbs, etc. He first mixes medium bronze lacquer with luminous powder and applies the same evenly over the surface of the glass. This gives the surface a frosted appearance, and by reason of the illuminating properties of the composition thus formed when applied to one-half of a light globe, acts as a reflector. The lacquer, of course, serves to form an adhesive base for the powder. Where the reflective characteristics are undesirable simply the lacquer is applied and the illuminous powder omitted. This would especially be true in coating fabrics. The second step is to mercerize white rubbing varnish and apply the same evenly over the first mixture after the latter has thoroughly dried. The third step is to dust this surface before drying with gold-bronze powder. The surface is then dried. The final step is to subject the article thus coated to a copper bath, after which it may be painted or enameled.

WINDING ELECTROMAGNETIC COILS has long been a study with Mr. Richard Varley, of Providence, R. I., who has recently secured a patent on some further developments in that direction. In machines for winding coils, especially those adapted to wind a number of coils simultaneously and known as "automatic multiple winding machines," it is desirable for various reasons to allow the strand guide which forms the layers to be located quite near the surface of the winding, and as the strand guide is usually a pulley and occupies considerable space it cannot be used between the flanges of a spool, because its motion is interrupted by the flanges at each end of a layer, with the result that the layers are not finished or at least are roughly finished. To dispense with the flanges and still preserve the integrity of the coil during its winding and after, the practice has been introduced of inserting a sheet of paper between every two layers of the winding, allowing it to extend laterally beyond the end convolutions of the layers and then winding a given number of turns in each layer, while in the multiple machines each sheet of paper thus inserted is wide enough to extend throughout all of the coils on the spindle. The coils thus build up more or less solidly; but it is still found, especially in winding the coils of larger diameter, that the tension of the wire or the jarring of the machine or handling after the coil is finished will cause the end turns of the layers of wire to break or bend down the unsupported projecting portions of the paper, and so loosen from the main body of the coil. The object of Mr. Varley's invention is to introduce a process of winding coils either singly or in multiple and involving the introduction of paper between the layers wherein the end convolutions of each layer will be securely confined and the integrity of the coil maintained throughout the winding operation and afterward when the coil is in use. This is done by building up end flanges for the coil as the diameter of the coil increases by providing each sheet of paper introduced between the layers with thickened or reinforced bands, which form stops for the end turns of the layer wound directly upon the sheet. The thickened bands are obtained by pasting strips or ribbons of paper upon the face of the sheet at a distance apart equal to the width of the layer. In multiple winding each sheet will have a number of the bands, depending upon the number of coils wound at once, and preferably one band between any two coils will serve for both; but it will be of sufficient width to be divided along the middle when the coils are removed from the winding spindle, allowing one-half to each.

LETTERS TO THE EDITORS.

Hydraulic Units.

To the Editors of Electrical World and Engineer:

SIRS:—Referring to the paper by Mr. Montagu, "A Suggested Hydraulic Unit," I beg to give you a simple old rule which has been used for decades in continental Europe for the calculation of water power. This rule is especially fitted for illustrating the advantages gotten by the use of the metric system.

Let Q be the flow of the stream in cubic metres per second, H the height of the fall in metres. The available power of the fall in kilogram-metres per second is, then, $1{,}000\ Q\ H$, since one cubic metre of water weighs 1,000 kg. The available power in horse-power is $1{,}000\ Q\ H \div 75$, since 75 kilogram-metres per second are equal to one (continental) horse-power.

The effective power of the fall, measured on the turbine shaft is found by multiplying the available power with the efficiency. Now, the efficiency may be assumed for a first calculation as equal to 0.75. In this way the effective power of the fall, W, measured in horse-power, is

$$W = .75\ \frac{1{,}000\ Q\ H}{75} = 10 \times Q \times H$$

The value of 0.75 for the efficiency holds good for many cases. With Pelton wheels and other types of very high efficiency, 0.75 may be taken as the combined efficiency of the turbine and the electric generator

VIENNA, AUSTRIA. E. ADLER.

Barbed Wire for Lightning Protection.

To the Editors of Electrical World and Engineer:

SIRS:—In your issue of July 18th last, there appeared some comments on Mr. Ralph D. Mershon's paper on "The grounded wire as a protection against lightning" at the Niagara Falls convention of the American Institute of Electrical Engineers.

As the public here generally lay it to deficient apparatus, not to say carelessness, when there is any accident due to lightning, it occurred to me to translate your comments and publish them in a local newspaper with an obvious object. The publication at once called forth an answer from a local "expert," and thinking that you, as well as Mr. Mershon, would probably be surprised to learn how little you know about the matter in hand, and how much is known of which you have no knowledge, I have also translated the aforesaid answer and sent it to you herewith. I trust you will find it instructive. It is at least evident that you are not aware of your "total ignorance of the most ordinary phenomena relating to electricity."

SANTA ANA, REPUBLIC OF SALVADOR. W. C. MCENTEE.

(The enclosure is as follows:

"To doubt the superiority which a grounded barbed wire has over a plain wire as a protection for loaded aerial conductors would be to admit a total ignorance of the most ordinary phenomena relating to electricity. Ignoring the theories of the physicists, in practice it is constantly observed that the electric fluid concentrates at the points of bodies in which it circulates, each one of these becoming a kind of squib which expels if the charge is positive or absorbs if it is negative. The charge of a wire in connection with the earth is negative and the deeper the ground connection the stronger the charge, and its radius of protection increases with its elevation above the other conductors charged with the opposite electricity. This wire, then, being barbed, each of its points is a small open mouth through which the lightning passes to the ground, leaving unaffected, or at least weakly influenced, all objects within the circle of protection. A plain wire receives, it is true, the inductive force of lightning, but with a difference with respect to the barbed wire of about four to one in favor of the latter.

"A simple experiment will better convince: Carry into a dark place, a room for instance, the extremity of a bare aerial conductor charged positively, and three or four kilometres long, which in most of its length runs through country where there is little high vegetation, so that it may receive the full charge that the lightning induces in it. Three millimetres from this and parallel to it, place another conductor about two metres long, having connected in the middle of it a piece of barbed wire half a metre long, grounded at both ends by burying six or eight metres in moist earth. When lightning occurs it will be observed that all the points of the barbed wire which are presented to the conductor which come from outside will be

illuminated, producing at the same time a loud crackling sound; but no alteration whatever will be noticed in the plain part of the same conductor. It is not to be for a moment doubted that this phenomenon is owing to the resistance that the neighboring points oppose to the free circulation of the excess of electricity induced in the rural conductor, and to the avidity with which these absorb the excess referred to. And then let a Mr. Mershon come, electrical engineer, forsooth, and say that the barbed wire offers no advantage over the plain wire as a protector of aerial electrical networks.

"As a further proof I will refer the following case: Once on a time it happened that some perverse person broke a telegraph line, taking away a piece of the wire; the lineman in charge, on arriving at the break, found he had not with him sufficient wire to supply the missing length, so he cut a piece out of a barbed-wire fence in the neighborhood and joined up the line with it, innocently believing that his *industry,* the secret of which he guarded, deserved a prize. During four days communication was impossible over that line, after which, having exhausted every means of re-establishing it, I decided to go myself over the line, and like the Roman I arrived, I saw and I took away that which they say is only good for protection against cattle. Communication was at once perfectly re-established; the points had played their part marvelously; connected as they were, in series, with a wire of positive currents, they had become so many doors of exit."—*Santa Ana Democrat,* September 30, 1903.)

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Diagram of the Repulsion Motor.—OSNOS.—A long mathematical article, illustrated by diagrams, in which the author shows that for the repulsion motor the relations between current, phase difference and torque, etc., may be represented simply in form of a diagram. In the same the locus of a point which determines the whole behavior of the motor is a circle, in a way quite similar to the case of the induction motor. (Concerning the latter see, for instance, Steinmetz, "Alternating Current Phenomena," third edition, pages 244-246, and the very elaborate discussion of this problem in Behrend, "Induction Motor.") The author first discusses the problem of the repulsion motor by the graphical method and afterwards develops the same and some additional results by purely analytical means. Fig. 1 represents an ordinary two-pole repulsion motor, the current being supplied to the stator winding, *s,* at the points 1 and 2. A line which connects the two brushes is generally inclined against the direction 1 2 by an angle α. In this figure the stator winding is shown as closed in itself, but this is no supposition for the following results, since the stator winding may consist of parts connected in series, so that the field has the direction 1 2. It is of no account whether the winding is of the ring or drum type, and the only supposition is that the motor has a case like ordinary induction motors; that is, with uniformly-distributed iron and a uniform air space over the whole circumference. Fig. 2 gives the diagram of the repulsion motor. $A\,C$ is the resulting stator field, so that the direction perpendicular to it is the voltage at the terminals, e, and the angle $F\,A\,B$ gives the primary phase difference. $A\,B$ is the primary current, $B\,C$ is the secondary current divided by $v_1 \cos \alpha$, where α is the angle shown in Fig. 1, while v_1 is the primary coefficient of stray field ("primärer Streuungsfaktor"), that is equal to the ratio of the magnetic reluctance of the primary field to the magnetic reluctance of the field common to the primary and secondary. The speed is indicated by the ratio $B\,H$ to $H\,C$, and the torque by the product of $A\,B$ by $J\,B$. The locus of the point B is a circle, the angle $A\,B\,D$ being constant. The point B_k represents the condition of the motor, braked to be at rest, so that $A\,B_k$ is the short-circuit current. $J\,B$ measures the torque for the unit of primary current. From the diagram it is seen that the relatively large decrease of the torque with the increase of the speed of the repulsion motor is not so much due to a decrease of the armature current (as was assumed heretofore), but mainly to the decrease of its phase difference against the primary current. At the point B_m the torque is zero, so that this point represents the maximum speed which the motor approaches when not loaded. In the ordinary series motor the maximum speed has theoretically an infinite value. This is not the case with the repulsion motor, so that the danger of the repulsion motor running up to a prohibitive speed is smaller than with the series motor. By analytical means the author shows that the displacement of the brushes of the repulsion motor may be used as well for braking as for regulating the speed.—*Elek. Zeit.,* October 29.

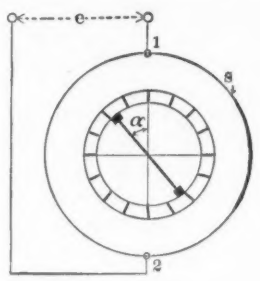


FIG. 1.—TWO-POLE REPULSION MOTOR

Compensated and Compound Alternators.—MEYER.—A reply to the letters of Heyland and Fynn, noticed in the Digest November 14. He knew that Heyland machines are being built and that some have even been tested, but what he contests is the claim of commercial superiority, or even equality with the standard revolving

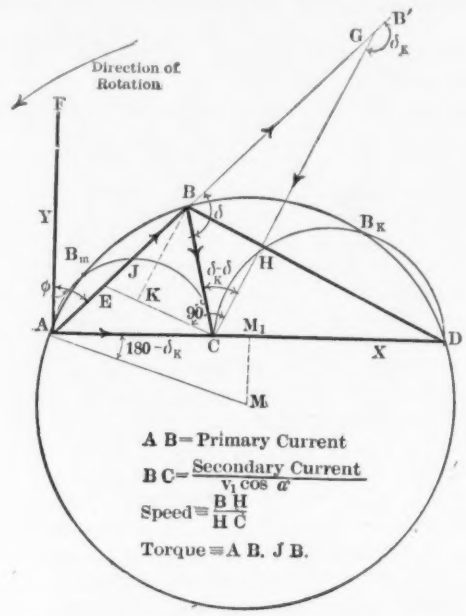


FIG. 2.—DIAGRAM OF REPULSION MOTOR.

field type of modern design, special cases excepted. The use by Fynn of a relay which, by means of magnetic clutches, acts mechanically on the rheostat of the exciter field, is, indeed, an old scheme, the drawback being the considerable time lag and its consequences. Concerning the new British Thomson-Houston device, he gives the following information: A constant resistance is put into the field circuit of the exciter, so that the voltage of the latter is reduced to about 40 per cent. of its normal value. In parallel with this resistance is a circuit containing a contact device which short-circuits and open-circuits the exciter resistance in rapid succession, thereby changing the exciting current to a more or less pulsating current. The frequency of the make and break of this current is controlled by the voltage and the current of the generator and varies from about 1 to 20 per second. The smallest drop in the voltage will cause the rheostat to be short-circuited for a longer period, thus raising at once the voltage of the exciter and of the main generator. The rapidity of action and reaction is such as to keep the voltage practically constant for all such changes in load, power factor and speed of the engine as are experienced in modern plants.—Lond. *Elec.,* October 30.

LATOUR.—This author now also takes a hand in the discussion between Heyland and Meyer. He justifies his interference by saying that he has never ceased to claim complete priority of invention of the commutated machinery under discussion. He thinks that Meyer is mistaken in comparing the compensated motor with an ordinary induction motor. On the contrary, the compensated motor should be compared with the synchronous motor, over which it has the following advantages: First, unity power factor obtained automat-

ically at all loads; second, the rotor may be made much lighter (less copper and iron) in the compensated motor, and this without risk of its getting out of step under serious overloads; third, the compensated motor is not subject to hunting. He agrees with Meyer that the commutator-alternator is suited only to the construction of high-speed machines with few poles. He claims that the compounded commutator type of high-speed alternator is a cheaper machine than the present type of machine with separate exciters. In fact, in this type of machine the commutator and connections of the exciter are simply transferred to the rotor of the alternator, where they take the place of the collector rings. The voltage regulation is instantaneous and is obtained for each phase separately, thereby compensating for all dissymmetric loads on the circuit of any power factor whatsoever. The copper on the rotor of this type of machine does not sensibly exceed in weight the copper on the stator, which condition corresponds to the best possible economy. He concludes as follows: "The commutated alternating-current machinery forming the subject matter of my patents is not intended to bring about a revolution in electrical construction, as may be inferred from the large publicity given to the subject by others; but I am convinced that my machines are superior to the present type of high-speed alternating-current generators."—Lond. *Elec.*, October 30.

Asynchronous Generators.—McALLISTER.—An illustrated discussion on the Heyland asynchronous generator. The author points out that as in the case of the induction motor, the current which produces the m.m.f. for field excitation lags 90° behind the e.m.f. of the circuit and must be supplied from some source external to the machine. If this source be a synchronous alternator, the effect of the presence of the exciting current for the asynchronous machine may be eliminated by placing across the generator circuit condensers adjusted in capacity, so as to take an amount of leading current equal to the lagging current on the asynchronous generator. If this adjustment be exact, and there are no fluctuations in the load, no current will pass from the synchronous to the asynchronous machine, and the circuit between them may be opened without producing any effect whatever upon the operation of either machine. If additional load be placed on the generator, the e.m.f. will decrease, while if the load be decreased or removed the e.m.f. will only increase, the performance being similar in many respects to the direct-current, shunt-wound generator. Investigating the effect of varying the condenser capacity in the circuit, the author shows that assuming the asynchronous generator to run without load and with condensers adjusted in capacity to give normal e.m.f., if the capacity be increased, more leading current will flow through the condenser circuit, and this will increase the field magnetization and consequently augment the e.m.f. generated. This augmented e.m.f. will further increase the condenser circuit current, etc., and if the reluctance of the path of the magnetic flux remained constant this increase would continue indefinitely and the operation of the generator would be impossible. He gives a magnetization curve which shows the relation between the exciting current of an asynchronous generator and the e.m.f. at its terminals. This curve is similar in form to a mean "hysteresis loop" for iron with an air-gap in the magnetic circuit. Each point, however, represents the relation between the virtual value of the alternating current for excitation and the alternating e.m.f. produced at constant frequency. He shows that the asynchronous generator refuses to be excited when the condensance is below a certain value, and that only above the initial bend of the magnetic saturation curve does the operation become stable. The operation of an asynchronous generator with commutator excitation is quite similar to that of one excited by means of condensers. With a commutator generator, however, it is possible to use compound excitation, which consists in passing the load current by means of a set of auxiliary brushes on the commutator, through the secondary conductors, and thus to increase the field strength with the load and to counteract the effect of any lagging current upon the field magnetism and the circuit e.m.f.—*Am. Elec.*, November.

Electric Standardization.—A reprint of the resolutions of the British Engineering Standards Committee on standard direct-current pressures and frequencies. The matter had been considered by a special sub-committee on generators, motors and transformers. It was resolved, first, for lighting, that the standard direct-current pressures, measured at the consumers' terminals, shall be 110, 220, 440 and 500 volts; second, for traction, that the standard pressures, measured at the terminals of the motors, be, for tramways, 500 volts, and for railways, 600 volts. Concerning frequencies, there was some discussion whether, besides two standard frequencies of 25 and 50, there should be adopted a third one of 40 or 42, to enable synchronous converters to be used to the fullest advantage. All the arguments in favor of this third frequency were fully discussed; but after carefully weighing the pros and cons, the sub-committee decided not to recommend the adoption of more than two frequencies, namely, 25 and 50. A frequency of 25 periods per second was adopted for (1) systems involving conversion to direct current by means of synchronous converters; (2) large power schemes over long distances; (3) three-phase railway work, where motor gearing and the induction drop on the track rail have to be considered. A frequency of 50 was adopted for (1) mixed power and lighting on town supply mains; (2) ordinary factory power plant; (3) all medium-sized power plants, where rotary converters are not employed. These recommendations of the sub-committee were submitted to the Electric Plant Committee, the Publication Committee, the Main Committee and the Board of Trade for approval. This has now been obtained.—Lond. *Elec.* and *Elec. Rev.*, October 30.

Editorial Notes.—While no recommendation is yet made by the committee for standard alternating-current voltages, yet it would greatly be advantageous to make these the same as the direct-current pressures, as the manufacture of lamps and various fittings would be simplified and cheapened thereby. The standard frequencies adopted are those put forward by the British Institution of Electrical Engineers a few years ago. Although they are certainly good standard practice for general use, it may not always be advisable to adopt them in particular cases. For instance, it seems that frequencies of 30 and 60 frequently make the design of turbine-driven sets easier.—Lond. *Elec.*, October 30.

The Inventor of the Dynamo.—An account of recent court proceedings in London and an editorial on the subject. Dr. H. Wilde had brought an action to restrain Prof. S. P. Thompson from referring, in books of which he is the author, to certain electrical machinery as being "dynamo-electric machinery," Dr. Wilde himself claiming the distinction of being the inventor of the dynamo and dynamo-electric machinery, and objecting to the invention being accredited to any one but himself. The lower court and the appeal court decided in favor of Thompson. The same issue contains a long letter by S. P. Thompson on the definition of a dynamo. The word is used by authoritative writers in two different senses, either in the narrow sense of the self-exciting machine or in the wide sense, including all machines in which mechanical movement is used to generate an electric current, only the electrostatic class being excluded by common consent. On the other hand, what Dr. Wilde had in effect sought by his libel suit, was to force everybody to employ the term dynamo only for separately-excited machines.—Lond. *Elec.*, October 30.

REFERENCES.

Induction Motor.—HOXIE.—The conclusion of his paper on the induction motor and its engineering capabilities. In this last installment he discusses its general capabilities and says that for any service requiring a nearly constant speed the induction motor is suitable. For a large starting torque, together with good speed regulation, special devices may be added. For services requiring variable speed and a torque varying inversely with the speed, the induction motor is not primarily well suited, and it is only with difficulty that it can be adapted to such service. He discusses in detail the use of the induction motor in cotton mills, machine shops, for operating pumps and fans, for use as a frequency changer, for operating elevators, and finally for traction. The author is careful not to express any definite opinion concerning the suitability of the induction motor for traction. He compares the theoretical advantages of the induction motor and of the direct-current motor for traction concerning initial cost, method of control, maintenance of schedule, operating convenience and efficiency. He thinks it is possible that the induction motor may ultimately be used for traction purposes upon the large trunk lines of this country.—*Jour. Franklin Inst.*, November.

Construction of a Small Variable Voltage Transformer.—ROBERTS.—An illustrated article on the design of a small transformer having a maximum capacity of about 80 watts and capable of furnishing a secondary pressure that can be varied from zero to about 5 volts. The illustrations are all dimensional drawings and the constructional details are fully explained in the text.—*Am. Elec.*, November.

Alternators.—An illustrated description of the construction of alternating-current generators by a British manufacturing company. It is said that the time is now over when engineers of English tram-

way and lighting systems were compelled to obtain their alternating-current machinery from abroad.—Lond. *Elec. Rev.*, October 30.

LIGHTS AND LIGHTING.

Osmium Lamp.—Some additional notes supplementing those given in the Digest November 14. The range of voltages for which the lamps may be used has recently been increased and lamps for 55 volts are now supplied by the Austrian Gasgluehlicht und Elek. Ges., of Vienna. From a report of Wedding it appears that two groups, each consisting of six lamps, of 37 volts, were connected in series across 220-volt supply mains. In one of the groups, for the first 3,132 hours, the average life of the six lamps was 2,853 hours, and the average candle-power fell from 30.1 to 23.7, the mean consumption in watts per candle-power rising from 1.46 to 1.78. After 520 hours the first lamp collapsed, and after 3,724 and 3,940 hours, respectively, two others gave way, the remaining three still burning after 3,973 hours. For the second group, which consisted of six 25-cp lamps, the average life was 1,479 hours, the candle-power dropping in 2,198 hours from 25.1 to 19.9 and the energy consumption increasing from 1.37 to 1.75 watts per candle-power. The filament of the lamps is made up of two loops, which are held apart by insulating stays attached to the interior of the glass bulb.—Lond. *Elec.*, October 30.

POWER.

REFERENCES.

Electric Pumps for Water Works.—OELWEIN.—A very long and profusely-illustrated article on the electric pumping installation of the water works of the city of Urfahr, in Austria. It was found that electric pumps would be cheaper than steam pumps.—*Zeit. d. Oesterr. Ing. u. Arch. Ver.*, October 30.

Blast Furnace Gas Engines.—PERKINS.—An illustrated description of a 1,600-hp gas engine and three-phase alternator at the Laar power plant in a mining district in Germany, and of other high-power blast furnace gas engines installed abroad.—*Elec. Rev.*, November 7.

TRACTION.

Underground Railway Accident in Paris.—A summary of the disclosures made at the official investigation of the recent accident on the Metropolitan Underground Railway, of Paris, which resulted in a large loss of life. The interesting fact was established that the motorman on the disabled train discharged his passengers at a station and had his train pushed by the following train, which had also discharged its passengers at the same station. However, the motorman on the disabled train neglected to raise the third-rail shoes and open the motor cut-out switches in the controller. When the explosion occurred which brought the train to a standstill, it was seen that the head motor car and the first trail car were on fire. As the third-rail shoes on the motor car had not been raised an arc was maintained under the car which prevented the employees from extinguishing the fire, and soon the entire train was in flames. The bodies of the cars were made of pitch pine and no effort had been made, evidently, to fire-proof them. The heat caused by the fire destroyed the lighting and telephone cables and the tunnel was enveloped in disastrous darkness.—*St, R'y Jour.*, October 24.

Resistance of Road Vehicles to Traction.—An illustrated reprint in abstract of a report of a committee of the British Association. The first experiments were made with iron-shod wheels. The tractive effort increases with the velocity, but the curves representing the tractive effort as function of the velocity are concave downwards, showing that the rate of increase of the tractive effort diminishes with the velocity. This may be due to the fact that as the wheel travels faster, it has less time to fall into the little holes in the roadway, merely skimming along the tops of the ridges. Well-laid setts under these circumstances, even with wide, deep gaps, form a perfectly smooth track at high speeds. In some tests it was even found that the tractive effort was smaller for setts than for macadam. Further tests were made with pneumatic-tired wheels, and it was found that the ratio of tractive effort to load is very nearly constant and that the tractive effort increases slightly with the velocity. Under similar conditions as to road surface and speed, the tractive effort is less for tires of smaller cross-section than for those of larger cross-section. The rolling friction may be expressed by the formula $f P \div D$, in which f is a coefficient expressed in kilograms, varying with the nature of the road and the width of the tire, its value for a smooth, dry road being about 0.01. P is the total load on the vehicle in tons and D is the diameter of the wheel. The axle friction may be expressed by the formula $s d \div D p$, in which s is a coefficient expressed in kilograms, varying with the mode of lubrication and the nature of the rubbing surfaces, and being about 0.015. d is the diameter of the axle and p the weight of the car without the wheels. The tractive effort on the road covered with thick mud was found quite double that on a dry road. When pneumatic tires are used it must not be thought that springs can be dispensed with. The method of attaching plate springs to the frame is also a matter of considerable importance. The tractional resistance is reduced from 15 to 30 per cent., according to the nature of the road, by the use of pneumatic in place of metal tires. On good roads the width of tire has little effect on the resistance, and even on bad roads the advantage lies sometimes with the wide tires and sometimes with the narrow ones, according to circumstances. The best-known formula for the air resistance is $K S V^2$, in which R equals resistance in kilograms, S the projected area in square metres of total surface of vehicle on a plane normal to the direction of the motion, V the velocity on metres per second and K is a numeral coefficient which varies between very wide limits, according to the form and speed of the vehicle. The value of K is given as 0.0288, 0.0648 and 0.116 by Forestier, Bourlet and Tribault, respectively. The front of the car ought to taper and the back be yet more pointed, resembling the shape of a fish.—Lond. *Elec.*, October 23.

REFERENCE.

Railway Circuit-Breakers.—A description of an automatic oil circuit-breaker designed to take the place of the fuse block and hood switch, commonly employed on electric cars, also of a circuit-breaker designed for switchboard use and adapted specially for the protection of railway feeders.—*St. R'y Jour.*, October 24.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Modernized District Central Station.—An illustrated article, describing the power plant of the Bronx Gas & Electric Company at Westchester, N. Y. The company supplies all of the street and commercial lighting of the annexed district of Greater New York north of the Bronx River, with the exception of the district known as Williamsbridge. Two generators take the place of eight 125-light Brush machines and one 75-kw alternator, and they require but ⅓ of the space occupied by the nine old machines. The power house is located in a central situation convenient for the lines of the whole system, and stands upon the west bank of Westchester Creek, so that ample supplies of water are available for condensing purposes. Two 300-kw, two-phase, 2,300-volt machines, direct-connected to cross-compound engines of the vertical type, and a belt-driven, 150-kw, 2,300-volt machine constitute the generating equipment. The smaller machine takes care of the all-day load, the large machines only being used at night. Enclosed arcs are used for street lighting and these are fed through constant-current transformers.—*Am. Elec.*, November.

WIRES, WIRING AND CONDUITS.

Dielectric Losses in High-Tension Cables.—APT AND MAURITIUS.—A long article in which the authors give the results of an extended investigation of the dielectric losses in cables made for use at 20 to 30,000 volts. All cables tested were three-core cables, the insulating material being either rubber, impregnated jute, paper or a combination of these different substances. They determined the loss in the dielectric of the cable, which is the sum of two items, the loss due to direct passage of the current through the dielectric, and the loss due to dielectric hysteresis. The researches confirm what was to be expected from former investigations, made especially by Steinmetz with condensers, namely, that the energy loss in the dielectric is proportionate to the square of the e.m.f. This loss for a cable length of 1 metre is, therefore, equal to $c e^2$, where c is a characteristic constant of every type of cable, and the value of c determines the quality of the cable with respect to the dielectric losses in it. This value is small, so that instead of the value c it is more convenient to use the value C equal to 1,000,000 c, the loss figure ("Verlustziffer"), C, representing the loss in watts in the dielectric of the cable for a length of cable for 1,000 metres and a voltage of 1,000. While in Steinmetz's investigations voltages up to 950 only were used, the authors experimented with voltages up to about 30,000 and found the above quadratic law almost absolutely correct, as long as the insulation was of a strength that the safety limit of voltage was not ap-

proached in the experiments. Each of the three cores of the various cables used had a cross-section between 10 and 35 sq. mm., while the thickness of insulation varied between 3 and 7.5 mm. For these cables the loss figure, *C*, as above defined, varies between 0.42 and 14.3. Cables with pure rubber insulation have the highest loss figure. The Allgem. Elek. Ges., of Berlin, uses for high-tension cables a combined insulation, consisting of a layer of a non-vulcanized special rubber compound (the trade name of which is "red rubber," or "Rotgummi," around which a layer of impregnated jute is provided. The loss figure for these cables is in the average 0.67. The authors finally give an example showing the cable loss in a transmission line. If the loss figure is 0.7 and the voltage of operation is 20,000, the loss per kilometre of cable length is $0.7 \times 400 = 280$ watts. If the total high-tension cable line has a length of 100 km (about 60 miles), the total loss in the dielectric of the cable is 28 kw. This may be compared with the iron loss in transformers, which is also independent of the load. If the installation has a capacity of 10,000 kw in transformers, the loss will be about 2 per cent.—that is, 200 kw. The dielectric loss in the cables will, therefore, be only about 1/7 of the no-load loss of transformers. The greater the value of the transmitted energy compared with the cable length, the smaller becomes the dielectric loss in the cables compared with the no-load loss of the transformers.—*Elek. Zeit.*, October 22.

ELECTRO-PHYSICS AND MAGNETISM.

Dark Cathode Space.—G. C. SCHMIDT.—A paper in which the author develops a theory of the dark cathode space in analogy with the ionic theory of the electrolysis of aqueous solutions. If in an ionized gas a high current density is used, the regions near the electrodes will be deprived of ions since they are not re-formed immediately, nor does diffusion bring them back quickly enough to the impoverished regions. Since the positive ions very probably move more slowly than the negative ions, it is natural that the impoverishment should be greatest at the cathode towards which the positive ions migrate. The dark cathode space represents the region of impoverishment. This view is confirmed by the following experiment: On introducing into the dark space the terminal of an electrometer connected with a capacity, it takes a long time to get charged. It charges itself all the quicker, the more the electrode or probe is approached to the glowlight, and thus brought into a region of greater ionization. Anything that increases the number of ions in the dark cathode space, reduces the cathode fall of potential. Cathode rays and canal rays, when made to fall upon the dark cathode space, have that effect, but cathode rays are the more effective of the two. The cathode rays belonging to the cathode itself, if thrown back upon it by a metallic mirror, have the effect of reducing the dark space and the cathode fall of potential. The author traces some striking analogies between these phenomena and the phenomena in the electrolysis of copper sulphate.—From *Ann. d. Phys.*, No. 11; in Lond. *Elec.*, October 23.

Radioactivity.—SODDY.—The first of a series of lectures delivered at University College, London, on the subject of radioactivity. These lectures are afterwards to be published in book form. In the present lecture the author prefaces the study of Becquerel rays by the consideration of Röntgen rays, and traces the historical connection between the two discoveries. He gives a short account of the researches of Becquerel and the Curies. The most remarkable feature of Mme. Curie's work is considered to be her recognition of radioactivity as an atomic property. For if inertia is excepted, there is, strictly speaking, only one other atomic property, and that is weight, which alone is an additive property of the atoms. Radioactivity is in every respect a property upon which a method of quantitative chemical analysis can be based. It also furnishes a means of quantitative analysis. There are certain peculiarities which enable us to instantly recognize thorium or radium from uranium without performing a single chemical or spectroscopic test with the substance.—Lond. *Elec.*, October 23.

Thermo-Electricity.—MCCLELLAN.—A paper on the thermo-electric behavior of nickel nitrate.—*Phys. Rev.*, October.

ELECTRO-CHEMISTRY AND BATTERIES.

Manufacture of Ferro-Alloys in the Electric Furnace.—ROSSI.—An account of the extended researches of the author on the manufacture of ferro-alloys in general and of ferro-titanium in particular in the electric furnace. His method of reducing metallic oxides is based on the same principles as Goldschmidt's aluminothermic reaction. But while the latter uses aluminum in powdered form and mixes it intimately with the oxide to be reduced, Rossi carries the operation on in an electric furnace in a bath of aluminum. Aluminum in ingots, scrap or the like, is first charged in the electric furnace and the current started. It melts in a few minutes and in this molten bath he then shovels the metallic oxides. The reaction sets in at once and aluminum oxidizes with incandescence. As applied to ferro-titanium, the method consists in charging in the bath of aluminum the titaniferous iron ores; that is, titanic oxide associated with iron oxide. The iron is reduced first, forming a bath in which titanium reduced by the aluminum dissolves, yielding ferro-titanium. If rutile is used (titanic oxide practically free from iron oxide), and if a ferro-titanium of a certain percentage is desired, there is charged in the furnace, after or before the aluminum, the proper quantity of good scrap iron. This diminishes the expense of aluminum, as no aluminum is here required for reducing the iron oxide. He has made alloys practically free from carbon, containing from 0.12 per cent. to 0.75 per cent. carbon and from 10 to 75 per cent. titanium by the ton. Such alloys are very well adapted for the treatment of steel, but for seasoning cast iron he uses ferros containing carbon, from 6 to 8 per cent. and more, and obtained with carbon as reducing agent, since in this case the presence of carbon is of no consequence. The properties and applications of ferro-titanium are discussed in detail.—*Electrochem. Ind.*, November.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring the Resistance of Highly Insulated Substances to Perforation.—HOLITSCHER.—A communication criticising the method of Walter, which was described in the Digest on October 17. The writer claims that this method gives no definite indication of the resistance of the tested substances, for the reason that the results depend on the good condition of the drop of wax used and on the way in which the perforation of the wax is made with the fine needle. He therefore claims that this method is not suitable for general use because it greatly depends upon the skill of the operator. He proposes to continue to consider as the figure for the perforation voltage that value of the e.m.f. of a sinusoidal alternating current, for which the material is perforated without any drop of wax on it. In practice this value should be referred to a thickness of 1 cm. of the material. He suggests not to use metallic points, but plates of 10 sq. cm. In all researches of this kind it has been found that the perforation voltage is not absolutely proportional to the thickness of the substance, but for increasing thickness it is somewhat smaller than would correspond to the law of proportionality. The difference, however, is negligible in practice up to the certain thickness and voltage. —*Elek. Zeit.*, October 22.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Transmission of Signals on Ships.—An illustrated article in which reference is first made to the use of electrical methods of communication on American warships. Much of the signalling is done by

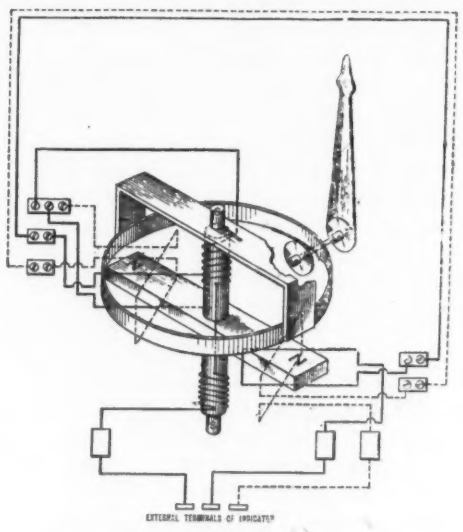


FIG. 3.—SHIP SIGNALS.

placing a series of lamps behind a number of translucent signals and illuminating the lamp corresponding to the signal which it is desired to give. It is thought that this method is rather primitive and entails running a separate wire for every signal, and it is difficult to see the

signal in a bright light. A description is then given of the Richards-Evershed ships' telegraph which has been in use in the British navy for many years for the purpose of indicating to the officer in charge of the ship the angle to which the helm has been put over. The system consists essentially of an indicator constructed on the ohmmeter principle, in which the position of a needle is determined by the ratio of the currents in two coils placed at right angles to one another, while the transmitter consists essentially of a series of resistances provided with contacts over which a switch can be moved. If one of the ohmmeter coils be connected to one end of this series of resistances and the second to the other end, while the current is led in through the movable switch and taken out at the other end of the ratio coils, which are joined together, it follows that the position of the needle in the ohmmeter coils will depend upon the position of the switch. The arrangement can be clearly seen in Figs. 3 and 4, which give a perspective sketch of the needle index and gear connecting them, together with a diagram of the connections of the coils by which the needle is magnetized, and by which its position is determined. In the helm indicator the transmitter contains the resistances and a switch arm, the latter being moved by two parallel coupling rods by which it is attached to the rudder stock. The position of the switch automatically determines the position of the needle of the indicator, and any one of several indicators can be switched into circuit with the transmitter. In this manner it is possible for the officer in charge to obtain automatic signals from the helm either on the bridge or at any other steering station to which it may be desired to make connection. In no case is it necessary to use more than three wires, and it is customary to use three-core cable having three wires covered in distinctive colors, so as to facilitate the operation of connecting up on board. A second application of the system is the use of the apparatus as steering telegraph, which is also described.—Lond. *Elec.*, October 30.

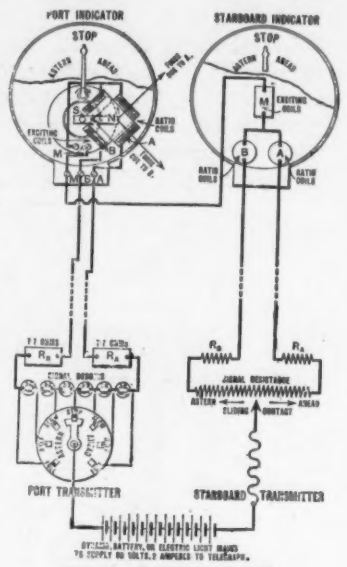


FIG. 4.—SHIP SIGNALS.

REFERENCES.

Secrecy of Telephone Messages.—SALZER.—An article illustrated by diagrams on telephone systems in which one party may call up and speak with another party independently of a third party (exchange). Such systems have generally the disadvantage that secrecy is not guaranteed, for the reason that on account of inductive actions and of current distribution, simultaneous messages are impressed on the whole network, so that the clearness of speech is diminished and there is no secrecy. The author discusses the reasons of this disadvantage and shows how it may be counteracted.—*Elek. Zeit.*, October 22.

Wireless Telegraphy.—PRASCH.—The first part of an illustrated article in which the author explains with the aid of diagrams the essential distinguishing features of the various systems of wireless telegraphy.—*Zeit. f. Elek.* (Vienna), October 18.

Fire Alarms.—An illustrated description of an automatic fire alarm for use in buildings, made by a German company.—*Elek. Anz.*, October 18.

New Books.

KONIGLICHEN TECHNISCHEN HOCHSCHULE ZU AACHEN. By Dr. Wilhelm Borchers. Halle: Wilhelm Knapp. 62 pages, 89 illustrations. Price, 6 marks.

This book describes the new Laboratory of Mining and Metallurgy of the Institute of Technology of Aachen, with an account of the author's and his students' work in his old laboratory. The new laboratory appears to be well equipped for electric furnace experiments, various types of furnaces being described and illustrated. A chapter of the book dealing with measuring instruments has been written by Dr. Danneel.

EINRICHTUNGEN VON ELEKTROLYTISCHEN LABORATORIEN. By H. Nissenson. Halle: Wilhelm Knapp. 51 pages, 32 illustrations. Price, 2.40 marks.

This volume is another one of the series of monographs on applied electrochemistry, edited by Victor Engelhardt. The reviewer looked forward with pleasure to reading the little book, as he realized that it promised to fill a gap in the literature on electro-analysis. Electro-analytical methods, on account of their simplicity and quickness, are becoming more and more used in practice. The text-books on electro-analysis, however, do not contain the data required to enable the chemist in practice—especially if he belongs to the old school and does not know very much about electricity—to put up an electro-analytical installation to the best advantage. The author of the little volume under consideration is an authority on the subject of electro-analysis and a pioneer in the application of electro-analytical methods in practice, in the large industrial laboratory, of which he has been the director for many years. He is, therefore, eminently qualified to write on the subject and it was hoped that he would embody the results of his experience in this book for the benefit of the man in practice. These hopes are, however, doomed to disappointment, for after a few pages of general matter he contents himself with a mere description of a dozen or more installations, the great majority of them being University laboratories. Included among the latter is that of the University of Pennsylvania, built by Dr. Edgar F. Smith, the foremost authority on this subject in America. On the last few pages the author describes and illustrates his own installation in its historical development. He concludes with the following sentence: "As the result of a more than two years' use of my installation and a thorough observation of other installations, a number of changes have again been found desirable, in order to cheapen the running, simplify the manipulation and increase the accuracy of the results obtained. I will discuss sure roads (sichere Wege), which lead to this end, in a later publication, entitled, "Most Suitable Installation of Laboratories for Electrolysis in Metallurgical Works.'" It is to be regretted that, as he was writing the book under consideration, which covers the same subject, he omitted to avail himself of this opportunity.

THE PRACTICAL PHYSICS OF THE MODERN STEAM BOILER. By Frederick J. Rowan. Introduction by Dr. R. H. Thurston. New York: D. Van Nostrand Company. 638 pages, with 314 diagrams and plates.

The purpose which the author of this work has consistently held in view throughout seems to have been the development and presentation in detail of the broad underlying principles upon which boiler design and construction, and especially improvement, must be based. We find accordingly a historical sketch of the development of the modern steam generator, and in particular a full presentation of the characteristics of the modern boiler of the water tube type. We find further a large amount of descriptive matter relating to modern forms of boiler, particularly of the water tube variety. This portion of the book constitutes the descriptive part and represents the matter intended to provide for the general acquaintance of the reader with the subject in hand. Next, coming closer to the purpose of the book, is a full discussion of the physical laws relating to the combustion of fuel, the transmission of heat, the circulation of water, the action of changes of temperature on the structure, the general relation of the structure to the stresses it is called on to bear, the corrosive influence and prevention of scale deposits. On all these topics a large amount of information based on actual experience, is furnished, together with a clear, careful and full statement of the physical laws involved. A further chapter contains a large amount of information drawn from boiler tests of various types, and especially such as have special value by reason of their extent or the care with which they have been carried out.

Throughout the work the author is more concerned with physical principles and laws, and their application in particular to the improvement of the boiler, than he is with present-day practice in minor particulars or with constructive details. The keynote of the work is "improvement," and the various physical laws are presented and discussed with this particular end in view. The prominence of the author in the engineering world would lead us to expect a treatment of the subject which will be clear in style, ample in scope, having in view his expressed purpose, and authoritative in character. In these expectations we are not disappointed, and the book must certainly take a leading rank in the standard literature of the subject. It will be found a most acceptable addition to the working

library of all those who are concerned with the great problem of the betterment of the steam boiler as a factor in our modern industrial civilization.

BOOKS RECEIVED.

OPERE DI GALILEO FERRARIS. Vol. II. Milan: Ulrico Hoepli. 478 pages. Price, 12 lire.

LA TELEGRAPHIE SANS FIL. By E. Guarini. Bruxelles: Ramlot Freres et Soeurs. 64 pages, 88 illustrations. Price, 2.50 francs.

LA TECNICA DELLE CORRENTI ALTERNATE. By Giusèppe Sartori. Milan: Ulrico Hoepli. Vol. II, 480 pages, 290 illustrations. Price, 8 lire.

FOWLER'S MECHANICAL ENGINEER'S POCKET BOOK, 1904. Manchester: Scientific Publishing Company. 441 pages. Price, 2 shillings, sixpence.

Electric Railway Commission for St. Louis Exposition.

In view of the growing importance of the electric railway interests of this country, plans are being carried into effect which contemplate a very prominent recognition of the electric railway and electric railway problems at the St. Louis Exposition. The appointment of an Advisory Commission on Electric Railway Tests of the Louisiana Purchase Exposition has just been announced. The Commission is thoroughly representative of each branch of electric railway activity and will, undoubtedly, receive the support of the entire electrical industry in any plans for the promotion of electric transportation which the Commission shall devise.

The personnel of the Commission is as follows: Mr. J. G. White, president, J. G. White & Co., New York City, chairman; Mr. H. H. Vreeland, president Interurban Street Railway, New York City; Mr. W. J. Wilgus, vice-president New York Central & Hudson River Railway, New York City; Mr. George McCulloch, president Union Traction Company of Indiana, Indianapolis, Ind.; Mr. James H. McGraw, president McGraw Publishing Company, New York City.

The Commission will act in an advisory capacity in connection with a series of tests on electric railway apparatus to be conducted at the Exposition under the auspices of the Department of Electricity.

From Mr. W. E. Goldsborough, chief of the Department of Electricity, we learn that the electric railway test tracks have been laid north of the Transportation Building on the Exposition Grounds, and represent a practically level clear double track, 1,400 ft. in length. These tracks will connect with the Intramural Railroad and also the steam railway system serving the grounds. It is said that several important manufacturers have already promised complete equipments for exhibition and test, and the present outlook indicates that all of the new systems of alternating-current propulsion, as well as the old direct-current system, will be offered for inspection and operation.

It is not so much the intention to conduct these tests in a competitive sense as it is to arrange for the accumulation of data which will be valuable in promoting further electric railway undertakings from an engineering standpoint. A very complete equipment for testing apparatus will be provided, and all of the work will be done in a thoroughly engineering and scientific manner.

Dr. Hans Goldschmidt on Aluminothermics.

Aluminothermics is the name of a new branch of engineering, all applications of which are based on the fact that the combination of aluminum with oxygen evolves a very large amount of heat, and that this reaction, when started at one point of a mixture of powdered aluminum with a metallic oxide, goes on with great rapidity and produces a very high temperature. Such a mixture is called thermit, but what is mostly understood under this name is the special mixture of powdered aluminum and iron oxide. The vehemence of this reaction has been known for many years, but just for this reason the only use this reaction was put to was to make an interesting and showy laboratory experiment. Although Messrs. Green and Wahl succeeded many years ago in applying this reaction for reduction of metallic oxides, it was left to Dr. Hans Goldschmidt, of Essen, Germany, to make the reaction a controllable one, applicable with ease and certainty to a great many engineering purposes in which production of an extremely high temperature is required.

The development of this process has required a great many years, as is known to our readers from the Digest abstracts of papers which Dr. Goldschmidt had published from time to time. While the process is extensively used abroad, especially for rail welding in continental Europe and England, for repairing broken mining machinery, especially in the Transvaal, and for repairing broken stern-posts of ships, etc., in various countries, the process is practically untried on a larger scale in this country.

To introduce the various applications of his process in this country Dr. Hans Goldschmidt delivered an experimental lecture on November 13, before the Columbia University Chemical Society and many invited guests, in Havemeyer Hall, Columbia University. The large lecture room was crowded and the experiments of Dr. Goldschmidt were extremely successful.

The greater part of the paper dealt with the process of rail welding with or without clamps. It seems that the use of clamps has recently been found more and more superfluous, so that in many of the recent installations rail clamps were dispensed with. Even a butt weld can be obtained without clamps, particularly with rails already embedded. At Barmen, Germany, this was done very successfully about a year and a half ago. The old fish-plates were taken off, the ends of the rails were raised slightly by means of a crowbar and a shim was firmly wedged in between. In this case the shim was welded into the head of the rail.

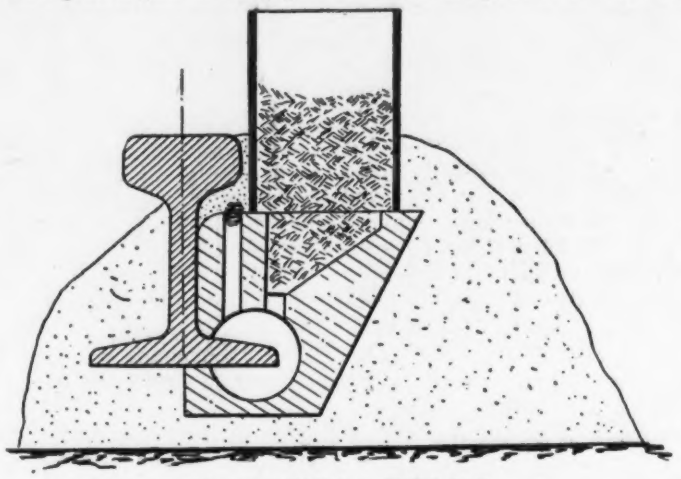


FIG. 1.—WELDING A THIRD RAIL.

When welding new rails not yet embedded, the use of rail clamps can be obviated by firmly wedging up the rail from the next succeeding joint.

When working without clamps, the time consumed per joint equals three-quarters of an hour for one man. Squads of four men, including foreman, do not use nearly so much time. At $1.50 per day the wages item of cost is 10 cents per joint. The use of the clamps doubles this amount. The other labor connected with welding remains the same whether clamps are used or not.

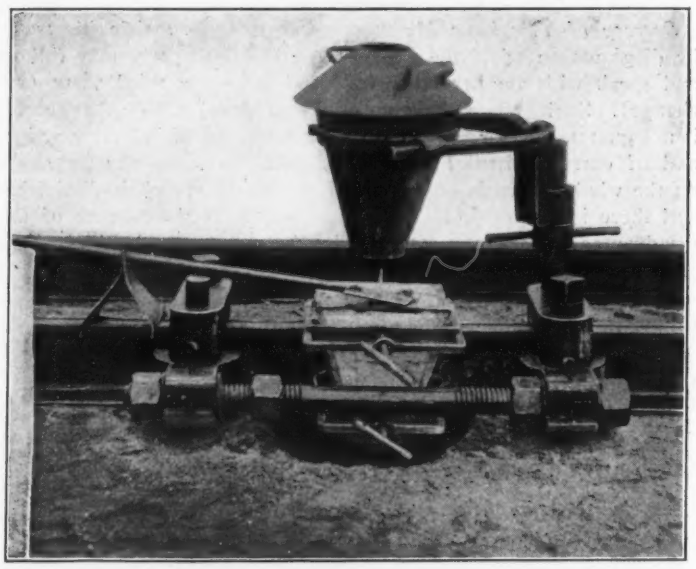


FIG. 2.—WELDING OUTFIT COMPLETE.

The moulds are in two parts and are sometimes made by the trolley companies themselves. The mould is screwed on to the rail and the rims are carefully smeared with clay where they touch the rail. Prior to this the rail ends are cleaned of dirt and dust with a wire brush and are slightly warmed, no sand-blast being required. In case the tops of the rails are to be butt-welded, the section has

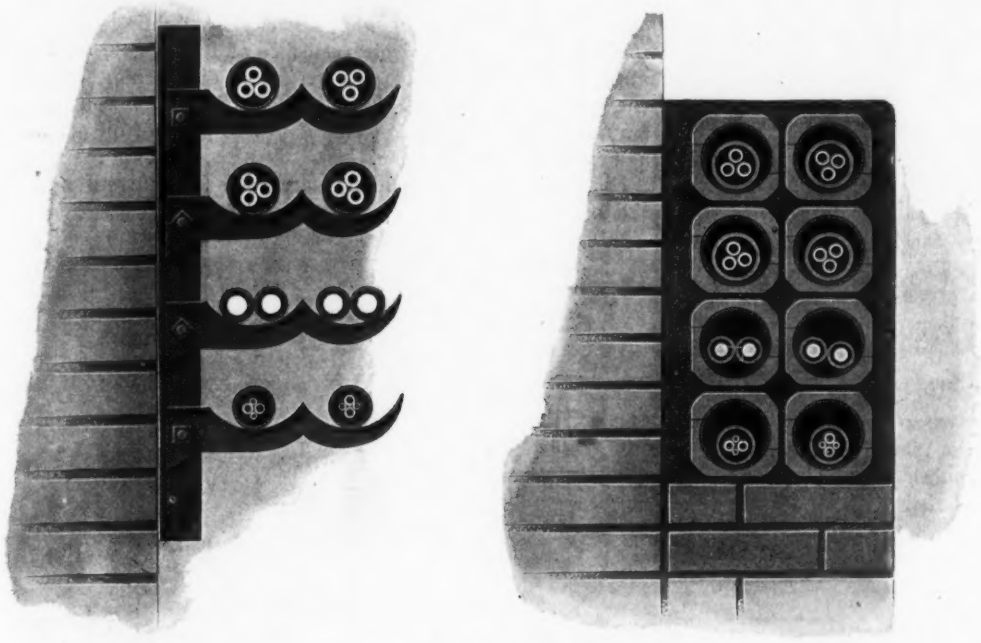
to be filled. This is all that is required in the way of preparatory work. A true alignment of the rail is, of course, necessary.

Each joint requires a distinct amount of thermit, according to the dimensions of the rail, and to avoid any mistake of the workingmen the amount of thermit required for one joint is given to the workingmen in a sealed bag. Since the trolley companies may make their own crucibles and moulds they will have to pay freight only on these "welding portions" which they buy from the manufacturer. The welding portion is filled into the crucible and about a thimbleful of ignition powder is added and ignited by a match. The reaction then goes on and the molten thermit iron flows into the mould and the weld is made. Recently the same method has been used successfully for welding third rail.

Other applications described by Dr. Goldschmidt were the production of pure refractory metals free from carbon, the repairs of broken machinery, the improving of iron and steel castings by means of anti-piping thermit and the welding together of wrought-iron tubes. His experiments in which two tubes were welded together was certainly one of the most beautiful ever shown in a scientific lecture. Recently the thermit process has been applied repeatedly to the repair of broken stern-posts of steamers and the time of the repair has been reduced from several weeks to a few hours, with a corresponding reduction of cost.

A New Divided Tile for Underground Work.

Considerable time and attention has been given to improvements in the underground installations of electric power plant conductors. Both the conductors and their insulating walls or the conduit proper have been considered. Various types of cables for the different



FIGS. 1 AND 2.—DIVIDED TILE.

classes of work have been developed. An improvement in the lead sheath and the insulation has taken place. The conduit proper, the method of laying the same, and the construction of the manholes have also been undergoing changes. All of these modifications have resulted in making as nearly a perfect underground system as possible.

It therefore seems somewhat strange that any item whatever has been neglected, but such is the case, as an inspection of such a system will show. In manholes and especially at stations iron racks have been constructed to carry the cables, which has proved very unsatisfactory. Such a point will prove a very good ground which will permit electrolysis and other destructive agents the more readily to proceed with their disintegrating work. When the insulation is once broken down, a destructive arc will ensue which may prove disastrous in its results. The lack of proper mechanical protection also in many cases is quite evident. This, in a great many cases, has been due to the fact that a suitable protective covering could not be applied, as the cables were already in position.

To overcome this difficulty and provide a covering as effective as at any other point in the system, a split tile has been designed by Mr. Ed. N. Lake, of the Chicago Edison Company. This is divided

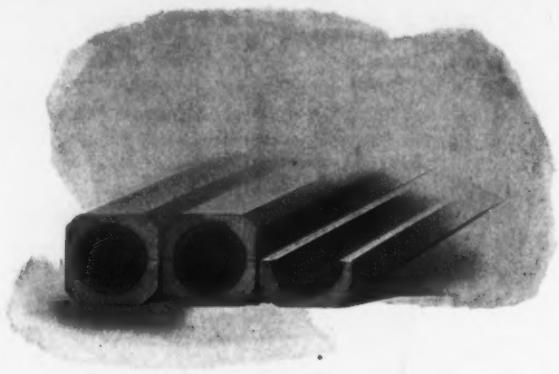


FIG. 3.—DIVIDED TILE.

in such a manner that the joints in the opposite walls are offset. The advantage of this, from a mechanical standpoint, is readily appreciated. From an electrical standpoint it will be seen that it is impossible for an arc in any one duct to be communicated to an adjacent one, a most desirable and necessary feature. For should an

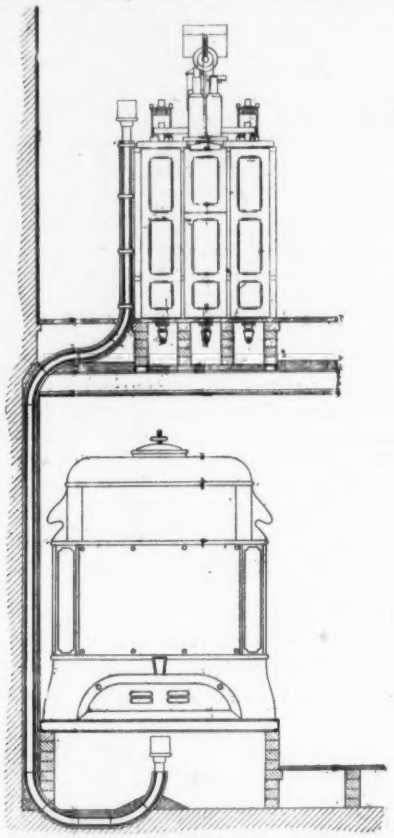


FIG. 4.—TYPICAL APPLICATION OF DIVIDED TILE TO HIGH-TENSION LINES IN SUB-STATIONS.

arc once be started, most serious results would follow where a large amount of power is concentrated in a small space, as is the case in many large power installations. The conduit, as will be seen from the cuts, Figs. 1, 2, 3 and 4, readily adapts itself to any and all conditions, and with the use of curved ducts can be employed for the most complicated cable run. The Lake divided camp tile is being made by the H. B. Camp Company.

New Electric Lighting Specialties.

The steady trend of improvement in the field of electric light and power brings with it demands for specialties of one kind and another, which shall more strictly answer the insurance requirements, as well as be more handy for installation and be of greater general efficiency and economy. Work done in this respect may not seem sometimes as important as that connected with the larger developments, but in the aggregate it has probably just as much to

do with the satisfaction given to the public and with the general safety and security of electrical methods.

A concern which has recently been putting forward some new specialties of unusual interest is the Banner Electric Company, of Youngstown, Ohio. A few of these are illustrated herewith, including its weather-proof, double-pole fuse cut-out, its entrance

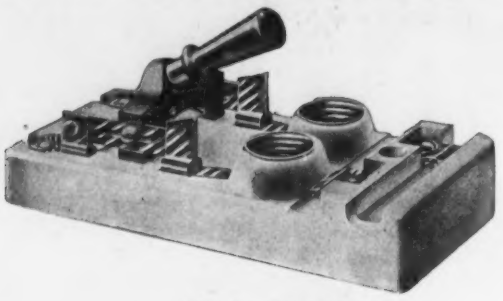


FIG. 1.—CUT-OUT.

switch and plug cut-out, and its floor boxes. A form of the entrance plug cut-out is shown in Fig. 1. One of the advantages of this is that combinations of these blocks may be used in the place of panel or tablet boards, so that what is virtually a switchboard

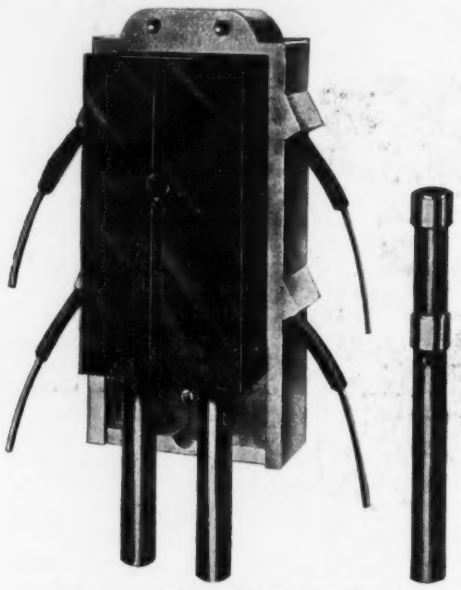


FIG. 2.—WEATHER-PROOF CUT-OUT.

can be built up from these units. They can be so arranged as to take off branches from one or both sides of the mains, each branch being supplied with switchboard and fuse connections. They are made for standard fuse plugs. The base is of glazed porcelain and

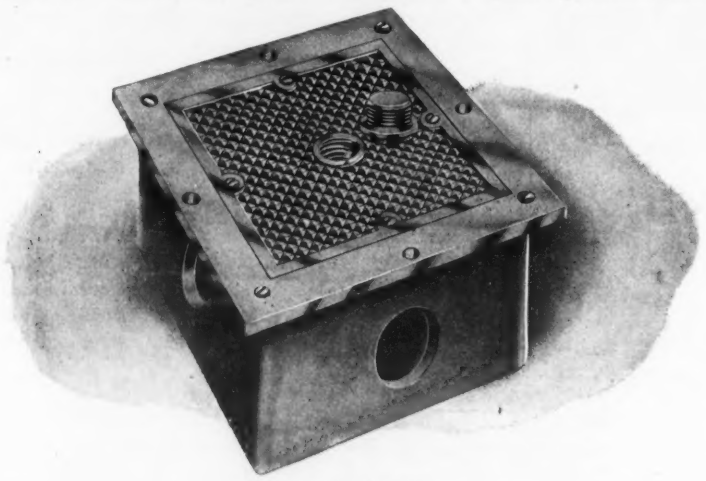


FIG. 3.—FLOOR BOX.

the copper and brass parts are highly finished, the whole being approved by the Board of Underwriters.

The weather-proof, double-pole fuse cut-out shown in Fig. 2 is an interesting device used principally in connection with alternating arc lamp service. The contact points cannot possibly be reached except by means of the fuse tubes shown in the cut, so that a heavier fuse than should be used cannot be connected. In this way the lamp is protected from excessive current, and the device can, of course, be used in many other ways where some protection is needed and can be afforded by using fuses of fixed capacity. The base of this is of glazed porcelain, and the contact points are round spring clips. The fuse tubes are of heavy hard fibre, carrying copper ferules, to which the fuses are soldered, the fuse passing through the side of the tube from one ferule to another. The arrangement is such that the tube cannot possibly jar loose or drop out when inserted in the clips, and a good contact is always insured. They are designed for 250 volts and any required capacity up to 30 amp. The positive and negative poles are separated by a thick wall of porcelain, minimizing the possibility of short circuit. The cover is of enamelled galvanized iron bolted to the porcelain and cemented securely around the edges so as to be water-proof. The inleading wires are soldered to the spring clips.

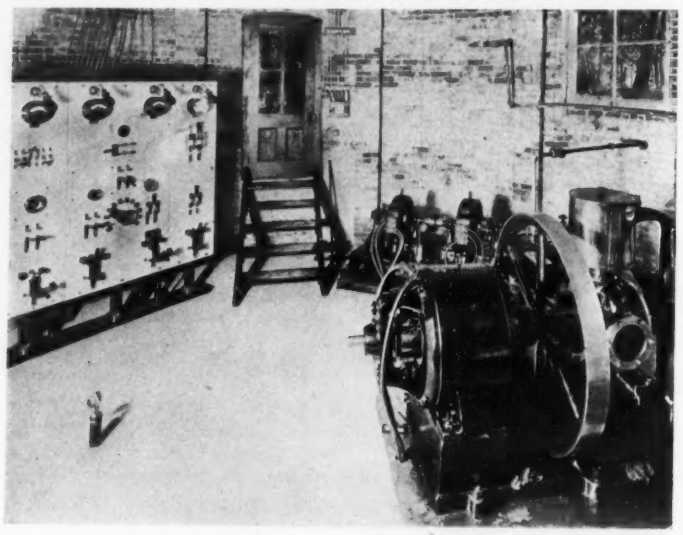
Fig. 3 shows a new form of floor box for conduit work and the type illustrated is that which has been designed for and is to be used by the new Government Bureau of Standards and laboratory which has recently been built at Washington. The lower part of the box is of cast iron, while the cover is of polished brass, the center field being finished in small raised diamonds sharply cut. The center plug screws in from the bottom of the plate and when in place comes flush with the top side. A rubber gasket is used between the brass cover and the iron box body so as to make it perfectly water-tight.

Among other supplies of the concern may be mentioned the automatic time switch and the heavy stamped copper terminal lugs. The Banner incandescent lamps are already familiar to our readers.

A Small Domestic Lighting Plant on Long Island.

An interesting example of a small electric lighting plant for domestic use is that of a private residence at Bayville, L. I., where current is generated by a 6½-kw generator direct-connected to a kerosene engine. It is stated that a current of 50 amp. at 110 volts (5½ kw) is generated on a consumption of 10 pints of oil per hour, the engine running at 350 r.p.m.

The connections of the generator are such that current may be furnished either directly to the main circuit or to a storage battery



SMALL PRIVATE ELECTRIC LIGHTING PLANT.

having a capacity of 240 amp.-hours. The regulation of the unit is stated to be within 2 per cent. from no load to full load, and less for intermediate changes of frictional loads. This outfit requires practically no attention beyond that of providing the proper supply of oil for fuel and lubrication. A small pump furnishes the exact amount of kerosene to the cylinder, and this is regulated by a centrifugal fly-wheel governor.

On the basis of the above figures, with oil at 10 cents a gallon, it is calculated that the cost of current for 100 16-cp lamps per hour is 10 cents, or .001 cp for one lamp.

The engine is of the Mietz & Weiss make, and the generator was furnished by the Bullock Electric Manufacturing Company. A Gould storage battery is used.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—During the early part of the week depression prevailed in the market, which, however, was followed by a rally. The United States Steel securities reached new low record prices, due to further reductions in quotations for some classes of steel products. These shares became steadier and rallied when it was announced that no cuts would be made in the price of rails or structural steel. This improvement, however, failed to help the general market. There was considerable foreign selling here, particularly in Pennsylvania Railroad, which in this market declined to the lowest figure since 1898. The entire railroad list was influenced more or less by the action of the leading stocks in this class. On Friday the market rallied on extensive covering by the short interest. Electric and traction stocks were not affected to any appreciable extent. Brooklyn Rapid Transit, on sales of 82,600 shares, gained 1 point, net, closing at 36¾, and Metropolitan Street Railway gained 3 points, closing at 112, the sales aggregating 25,700 shares. General Electric was weak, closing at the lowest price of the week, namely, 146¼, this being a net loss of ¾ point. The highest point reached by this stock was 149. Westinghouse common closed at the highest point of the week—138—thus gaining 3 points net. Western Union was steady, closing at 83. Following are the closing quotations of November 17:

NEW YORK.

	Nov. 10	Nov. 17		Nov. 10	Nov. 17
American Tel. & Cable	78	78	General Electric	148	149¼
American Tel. & Tel.	125	125	Hudson River Tel.	..	..
American Dist. Tel.	23	23	Metropolitan St. Ry.	111½	114
Brooklyn Rapid Transit	37	38¼	N. E. Elec. Veh. Trns.	..	..
Commercial Cable.	140	..	N. Y. & N. J. Tel.	140	..
Electric Boat	19	22	Marconi Tel.	..	..
Electric Boat pfd.	42	48	Western Union Tel.	82½	83½
Electric Lead Reduction	¾	*1	Westinghouse com.	134⅜	136
Electric Vehicle	5½	6	Westinghouse pfd.	162½	165
Electric Vehicle pfd	8½	8			

BOSTON.

	Nov. 10	Nov. 17		Nov. 10	Nov. 17
American Tel. & Tel	126¾	124¾	Western Tel. & Tel. pfd.	75	75
Cumberland Telephone	*115	*115	Mexican Telephone	1⅛	1⅛
Edison Elec. Illum.	240	*242¾	New England Telephone	123	120
General Electric	146	149	Mass. Elec. Ry.	18⅜	18
Western Tel. & Tel.	8	7⅞	Mass. Elec. Ry. pfd.	76	76

PHILADELPHIA.

	Nov. 10	Nov. 17		Nov. 10	Nov. 17
American Railways	42	..	Phila. Traction	95½	..
Elec. Storage Battery	45	48	Phila. Electric	6	5¾
Elec. Storage Battery pfd.	45	..	Phila. Rapid Trans.	11¾	11⅝
Elec. Co. of America.	7⅜	7¼			

CHICAGO.

	Nov. 10	Nov. 17		Nov. 10	Nov. 17
Central Union Tel.	..	..	National Carbon pfd.	86	85
Chicago Edison	140	..	Metropolitan Elev. com.	17	..
Chicago City Ry.	165	..	Union Traction	5⅜	5¼
Chicago Tel. Co.	120	..	Union Traction pfd.	29	25½
National Carbon	20	19			

*Asked

WESTINGHOUSE BRAKES.—The Westinghouse Air Brake Company, of Pittsburg, has been granted a charter with a capital of $11,000,000. The new company is a merger of the Westinghouse Air Brake Company, organized in 1863, and the Electro-Magnetic Brake Company, organized about two years ago with a capital of $5,000,000. The officers of the new company are: George Westinghouse, president; Robert Pitcairn, first vice-president; H. H. Westinghouse, second-vice-president; E. M. Herr, third vice-president; John Miller, secretary, and John Caldwell, treasurer. The Electro-Magnetic Brake Company manufactures electric brakes for street car service, and these will continue to be manufactured by the Westinghouse Air Brake Company.

HITCH IN MICHIGAN TELEPHONE.—An order staying confirmation of the Michigan Telephone sale until further orders has been granted by Judge Swan in the United States Circuit Court, Detroit. The order to show cause why the sale to the Old Colony Trust Company and N. W. Harris should not be set aside, is returnable this week. A bill of complaint against the Old Colony Trust Company, the Michigan Telephone Company and N. W. Harris has been filed. George W. R. Harriman is complainant and petitions alleging frauds. He asked leave to intervene and for a bill of review.

ELECTRIC STORAGE BATTERY.—In an interview in Philadelphia as to the outlook for Electric Storage Battery Company, President Herbert Lloyd says: "We are doing very well and the outlook is good. We will show considerably more gross earnings for the fiscal year ending December 31, 1903, than for 1902. The January dividend will certainly not be less than the last one. Out of the 50,000 shares of preferred stock I understand that now all but 3,000 or 4,000 have been converted into common."

TYRONE TROLLEY MORTGAGE.—The Tyrone Electric Railway Company, of Tyrone; the City Passenger Company, of Altoona, and the Altoona & Logan Valley Electric Railway Company (all subsidiary to the American Railways Company) have been merged under the name of the latter and a mortgage for $4,000,000 on their properties entered in favor of the Equitable Trust Company, of Philadelphia.

DIVIDENDS.—Niles-Bement-Pond Company has declared a quarterly dividend on the preferred stock of 1½ per cent. Pratt & Whitney Company has declared a quarterly dividend of 1½ per cent. on the preferred stock. American Railways directors have declared a dividend of 1½ per cent. (75 cents) a share, payable December 15, to stockholders of record November 30.

NEW YORK TRACTIONS.—When asked about the rumored plans for a consolidation of all the local traction companies, Vice-President Thomas F. Ryan, of the Metropolitan Street Railroad Company, said: "As far as the Metropolitan Street Railroad Company is concerned, there is absolutely no truth in the rumor."

UTICA LIGHTING BONDS.—The Utica Electric Light & Power Company has applied to the Stock Exchange to list $500,000 additional first mortgage 5 per cent. sinking fund bonds of 1950.

Commercial Intelligence.

THE WEEK IN TRADE.—A larger business was reported last week, due to the expansion of retail trade at the Northwest, which was favored by cooler weather, and at the South, where an enormous quantity of cotton is being marketed at good prices. On the whole, wholesale trade is still quiet, waiting developments in price and demand. There appears to be an excellent expansion in export trade. The October cotton reports were equal to the best recorded in any month, and wheat and corn are selling more freely and moving abroad in response to concessions forced by larger receipts, increasing visible supplies, liquidation and fear of foreign competition later. The exports of leading products aggregate the second largest total ever recorded for October. While the general outlook is favorable, there were some depressing features in the situation, chief among which were the reports that finished steel products had been cut; that wages of iron and steel and cotton mill employees must be reduced, and that among new strikes a general shut-down of Colorado coal mines menaces far Western manufacturing and railway activity. The gross railway earnings in October show a cheering gain of 5 per cent. over the progressive increases reported in that month for at least 6 years past. The reduction in the pig-iron output in the Pittsburg district alone is placed at 500,000 tons per month. On the other hand, high prices have checked demand. A favorable industrial development is the resumption of work by copper mines employing 30,000 men. A reduction of freight rates on steel from Pittsburg for export has been granted by the railroads. Sales of material in Europe by the leading American concerns are placed at 150,000 tons. Other metals show downward tendencies. Domestic purchasers of copper are still buying on a most conservative scale, and the aggregate of transactions has been extremely light. With the report of the reopening of the Montana mines, a heavy break in prices occurred here and in London. The closing quotations are 13½c. for Lake, 13¼c. for electrolytic, and 13c. for casting stock, these prices being nominal. The lumber market is irregular, but building activity is favored by the late favorable fall weather. *Bradstreet's* reports the number of business failures for the week ending November 12 as 250, against 216 the week previous, and 205 the corresponding week of last year.

HUGE NEW WORTHINGTON PLANT.—The International Steam Pump Company is building a huge plant at Harrison, N. J., which will be devoted to the manufacture of the Henry R. Worthington water works machinery, water meters, cooling towers, condensers, feed water heaters, centrifugal pumps, etc. It will be electrically equipped and will be the largest plant of its description in this country, if not in the world. There will be eight acres of roofing and double that extent of floor space. The new works will accommodate from 4,000 to 5,000 men and will cost in the neighborhood of $2,000,000. There will be nine large buildings, including a main

machine shop, with wide galleries, over 1,000 ft. long; an erecting shop 592 ft. in length of the same section as the machine shop, a high erecting shop 210 ft. long, four galleries in height, in the side bay, connecting the two shops. The main foundry will measure 600 ft. in length and there will also be a special foundry for small work, 410 ft. long, with a building 200 ft. by 60 ft. for cleaning castings connecting the two. The pattern building will be four stories high and 550 ft. long, and is to be divided by fire walls into four sections. The power house will be 172 by 102 ft. Electric power distribution is to be employed throughout and the grounds will be illuminated by electric arcs. The initial capacity of the power plant will be 1,000 kw. The General Electric Company has been awarded the contract for the generators. There will be special machines of 500-kw capacity each. The direct current to be taken off the commutator will be 250 volts. A third or neutral wire is to be connected to collector rings on the opposite side of the armature, so that a voltage of 125 can be taken off between either of the main wires, the neutral wire thus making a third-wire system in the one machine. The engines will be of cross-compound condensing build of 1,000-hp capacity each. The boilers—five units of 300 hp each—will be manufactured by Babcock & Wilcox. A steam turbine of 200-kw capacity will be installed for night run and lighting purposes. The plant has been designed so as to permit of the installation of a further capacity of 800 kw. Orders for a substantial number of machine tools have been allotted to the Niles-Bement-Pond Company and Manning, Maxwell & Moore. The plant is expected to be in active operation next fall.

THE GREGORY ELECTRIC COMPANY, of Chicago, reports a remarkable increase in the business brought about by the increasing of its facilities through the addition of its new warehouse and works at Sixteenth and Lincoln Streets. The cost of handling and overhauling the second-hand apparatus which it handles has been largely reduced thereby, and the company reports that September and October shipments are by far the largest in its history and enough orders have been booked to have November and December shipments as large or even larger. Among the recent shipments it reports the following: 25-hp Eddy motor, Electric Light & Street Railway Company, Sheboygan, Wis.; 33-kw Wood alternator, Albion, Ind.; 125-kw Thompson-Ryan generator, Grand Rapids Edison Company, Grand Rapids, Mich.; 15-hp Wagner alternating motor and a 10-hp General Electric alternating motor, Mayfield Manufacturing Company, Mayfield, Ky.; 15-kw Crocker-Wheeler generator direct-connected to Nash gas engine, A. Everett, Chicago; one General Electric 60-kw alternator, to the City Electric Light Company, Corry, Pa.

MEXICAN WATER POWER SCHEMES.—The construction of further large hydraulic plants in Mexico is contemplated by Andres Lefebre, of Vera Cruz. He has just secured a concession from the Mexican authorities permitting the utilization of 15,000 litres of water per second in the dry season and double that quantity during the wet period from the Zoacinco de Altotongo River, Jalacingo, State of Vera Cruz. Mr. Lefebre is also interested in a project to construct a water power plant on the River Maria de la Torre, State of Puebla. The franchise has been granted for the use of 10,000 litres per second in the dry season and 20,000 litres in the wet season. Other new Mexican projects of a similar nature include the using of 70,000 litres of water per second from the River Yaqui, State of Sonora, in which proposition Carlos Garza Cortina is the leading spirit. Carlos Castenada will also build a fair-sized plant on the River Lerma, State of Michoacan. All the plants are to generate current for lighting purposes principally.

FIGURES OF FOREIGN TRADE.—The month of October was not at all a bad one in foreign trade for the United States. The imports of merchandise in October amounted to $81,931,005, as against $87,424,070 in the same month last year. The decrease was entirely in dutiable goods, there being a considerable gain in the imports of those classes of merchandise which are admitted free of duty. The exports of the United States in October reached the grand total of $160,370,095. The exports in the same month last year were $144,327,428. The exports last month were larger than in any October since 1899. The balance in favor of this country was $78,439,000, or nearly $22,000,000 more than in 1902.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, of Chicago, reports an unprecedented number of switchboard shipments for the past two weeks of November. The shipments reached over 2,500 lines capacity, and consisted mostly of the well-known express switchboard equipments. A partial list of the equipments shipped includes: Richland, Mo., 200-line express; Herkimer, N. Y., 105-line express; Murray, Iowa, 200-line express; Germantown, Ohio, 100-line express; Palmyra, Ill., 200-line express; Richmond, Ind., 100-line express; Ozark, Ark., 100-line express; Wabasha, Minn., 100-line express; Fort Bayard, N. M. (United States Signal Officer), 50-line express.

SOME HEINE BOILER ORDERS.—The Heine Safety Boiler Company, of St. Louis, has secured a contract for two boilers of 200-hp capacity each for installation in the plant of the Edison Electric Illuminating Company at Pottsville, Pa. Two 300-hp units for an extension to the Electric Company of America's plant, of Rockford, Ill. The Citizens' Light, Heat & Power Company, of Montgomery, Ala., has requisitioned for two 300-hp boilers. The City Railway Company, of Wheeling, W. Va., has ordered three units of 300-hp capacity each. A 350-hp one is to be shipped the Denver (Colorado) Gas & Electric Company.

WESTINGHOUSE EQUIPMENT FOR CHILIAN NITRATE PLANTS.—In addition to securing the contract for the complete electrical equipment of the Victoria nitrate plant at Junin, the largest in Chili, the Westinghouse interests have secured substantial orders for machinery to be installed in two plants located in the vicinity of Iquique. Westinghouse generators will also be utilized for railway work at Antofagasta. These contracts were secured through J. K. Robinson, of Iquique, who is now at the offices of the William E. Peck Company, 116 Broad Street.

EQUIPMENT FOR NEW JERSEY STEEL PLANT.—The New Jersey Steel Company is to utilize electric power for the purpose of operating its plant at Rahway, N. J. The engineering and contracting firm of Mackenzie, Quarrier & Ferguson, 114 Liberty Street, have been allotted the contract for the complete plant. There will be a 300-hp Harrisburg tandem compound engine direct-connected to a Sprague generator of 200-kw capacity. The boilers, two units of 200-hp, will be of Heine build. The necessary motors will be purchased later on.

LIGHTING EQUIPMENT FOR MOST SOUTHERLY PORT IN THE WORLD.—Additional American equipment has been ordered for installation in the lighting plant at Puenta Arenas, Patagonia, the most southerly port in the world. The existing plant has a capacity of 50 kw, consisting of a Westinghouse engine and generator and a Bigelow boiler. The contract just placed by J. K. Robinson calls for a 150-kw Westinghouse generator direct-connected to a 250-hp Westinghouse engine. The boiler will also be of Bigelow build.

BOSTON ELEVATED CONTRACT.—The Boston Elevated Company has awarded a contract to the General Electric Company for the equipment with motors and controllers of 24 new elevated cars and 62 surface cars, the contract involving between $150,000 and $200,000. Under this contract the Boston Elevated people reserve the right to equip their present 150 "L" cars with the new General Electric-Sprague controllers, should the new controllers turn out as successful as the General Electric and Boston Elevated officials expect.

THE ALBERT DICKINSON COMPANY, Minneapolis, Minn., is building a new power house for its plant. As all the machinery is to be motor-driven, sufficient generator capacity for both power and light is being installed in the power house, complete in every detail, with ample provision made in the layout of the plant for any needed future extension. The Arnold Electric Power Station Company, of Chicago, is consulting engineer, and Barnett & Record, of Minneapolis, are the general contractors.

LIGHTING PLANT WANTED.—The light commissioners of Rushville, Ind., are asking bids until November 19 for one 100-kw and one 250-kw generators, direct-connected to engines, switchboards, piping, transformers, lights, etc.; also on one 250-kw, belted type, single-phase generator, one belted engine, belting, switchboard, piping, lights, etc. Mr. A. L. Stewart is engineer and Mr. Harry Larkin is the city clerk.

ELECTRIC BUSSES FOR AUSTRALIA.—The export commission house of Muller, MacLean & Co., 116 Broad Street, New York, has inquiries in hand for ten electric busses to be employed in Freemantle, Western Australia. The same concern is also figuring on electric elevators, both passenger and freight, for shipment to South Africa.

ANDERSON MATERIAL FOR ABROAD.—The Albert & J. M. Anderson Manufacturing Company, of Boston, Mass., has some substantial orders on hand from the British firm of Robert W. Blackwell & Co. A fair-sized order for wire has also been received from Buenos Ayres, Argentine Republic.

MORE EQUIPMENT FOR ELIZABETHPORT PLANT.—The A. & F. Brown Company, New York, is to extend the capacity of the electrical equipment of its Elizabethport (N. J.) plant. A 100-kw generator (belted) and a switchboard have been ordered from the C. & C. Electric Company.

ELECTRICAL SUPPLIES FOR AUSTRALASIA.—E. B. Latham & Co., 39 Vesey Street, New York, have recently secured fair-sized orders for electrical supplies through Muller, MacLean & Co., 116 Broad Street, for shipment to Australia and New Zealand.

C. & C. EQUIPMENT FOR CUBA.—The C. & C. Electric Company has a fair sized order in hand for lighting equipment for Cuba.

General News.

THE TELEPHONE.

LOS ANGELES, CAL.—Architect Frain, of this city, is preparing plans and specifications for a new building for the Home Telephone Company at Santa Barbara, to be located on Carrillo Street.

ALTON, ILL.—Announcement has been made in Alton that the Central Union Telephone Company will rebuild its lines in Alton at a cost of $30,000.

RICHVIEW, ILL.—William Rixman, proprietor of the Rixman telephone line, has completed arrangements to run his line into Nashville, Ill., and work has been commenced. This will put Richview, Ashley, Irvington, Walnut Hill, Centralia, Hoyleton and Nashville on a free telephone system, with free connection to local points on the Bell line.

ALEXANDRIA, IND.—The Alexandria Telephone Company has been organized by J. M. Walker, G. W. Kelly and O. W. Willits. The capital stock is $850,000.

INDIANAPOLIS, IND.—The Star City Telephone Company has been organized to operate exchanges in Pulaski, Fulton, Cass and White counties. The capital stock is $10,000.

SOUTH BEND, IND.—At a recent meeting of the board of directors of the South Bend Telephone Company, a semi-annual dividend of 2½ per cent on $200,000 capital stock was declared.

SHELBYVILLE, IND.—The exchange of the Mutual Telephone Company, of this city, has been closed for a week to make repairs. On examination it was found that mice had cut the tapes and destroyed many other parts of the apparatus.

RICHMOND, IND.—There are indications of a war between the telephone and telegraph companies on the one side and the city on the other because of the attempt by the city to remove poles and place wires underground. The Central Union Telephone Company, the Western Union and the Postal Telegraph Companies will fight the matter through the courts.

GREENSBURG, IND.—The Westport and Sardinia Telephone Company has been absorbed by the Decatur County Independent Telephone Company and will be operated through the local exchange in this city. This will increase the number of instruments operated by the Independent Company to 1350 and will give all subscribers access to the extreme southern part of the county.

INDIANAPOLIS, IND.—The case of the Cumberland Telephone Company vs. the City of Evansville was argued before Judge Anderson, of the United States District Court in this city on Nov. 5. The company asks an injunction restraining the city of Evansville from removing its poles and wires from the streets and alleys and from otherwise interfering with its rights in the city.

MILFORD, IND.—The Royal Independent Telephone Company established an exchange in this city last January. The company has extended its lines to New Paris, Syracuse, Millersburg, Oswego, Hastings and Warsaw. The rapid growth of this company is attributed to the support of the farmers which was secured by special inducements. The charges for telephones is $1 per month, but to every one taking one share of stock ($50) a 50 cents per month rate was allowed. This plan has afforded ample capital for the company to build five toll lines and secure long distance connections in many directions. The company is now building a toll line from Milford through North Webster, Oswego and Leesburg.

HURON, IA.—The Gimmell Telephone & Manufacturing Company, of Huron, has been incorporated with a capital stock of $200,000.

DES MOINES, IA.—The Boone County Telephone Company will install a modern switchboard to cost $20,000, and will expend as much more on new lines.

PIERSON, IA.—The Pierson Independent Telephone Company has been incorporated by John F. Brooks, J. C. Pierson, E. J. Raw, F. F. Nicholls, L. E. Heaton and J. H. Benson.

DES MOINES, IA.—The Douds-Leando Southwestern Telephone Company of Van Buren County has been incorporated with a capital stock of $500. The officers are: President, C. R. Dyer; vice-president, J. O. Boyer; secretary, W. E. Russell; treasurer, J. W. Wainscott.

TOPEKA, KAN.—The Linn Rural Telephone Company, of Linn, has been incorporated with a capital stock of $5000.

DETROIT, MICH.—The Monroe County Telephone Company, of Dundee, has applied for a franchise at Milan.

HART, MICH.—The business of the Mason County Telephone Company has been merged with that of the Oceana County Bell Telephone Company and the exchanges are to be consolidated.

YPSILANTI, MICH.—Mr. Garry Densmore has applied to the city council for a franchise for a telephone system. The maximum rates proposed are $24 per year for business instruments and $18 for residences, on a three-year contract basis. With no contract the proposed rates are $26 and $20. At the end of ten years the city shall have the right to purchase the plant.

MONROE, N. C.—The stockholders of the new Union Telephone Company met recently at Monroe and elected J. A. Justin, general manager. Work on the plant will soon be commenced.

WINSTON, N. C.—The Bell Telephone Company has recently added 80 drops to the system at Winston. A long distance line is also being built from Winston to Mt. Airy, N. C.

ASHEVILLE, N. C.—The complete merger of the telephone interests at Asheville with the Bell Company as sole owner has been completed. The Bell Company will take down most of its wires and will reorganize the plant of the absorbed independent company.

CLEVELAND, OHIO.—At the recent meeting of the Board of Directors of the Federal Telephone Company all of the present officers were re-elected.

HOPKINSVILLE, OHIO.—Arthur A. Hoge, of Lima, Ohio, was the successful bidder for a telephone franchise here and he will erect an exchange.

WEST MANCHESTER, OHIO.—The West Manchester Telephone Company has been organized and is preparing to install a new switchboard and connect up a number of subscribers in the rural districts.

FARMER, OHIO.—The Farmer Telephone Company, of Farmer, capital stock $10,000, has been incorporated by John Norway, P. C. Bigelow, D. C Lord and V. E. Cunningham.

CLEVELAND, OHIO.—The United States Telephone Company aided greatly in disseminating the reports of the Ohio election Nov. 4. The company has connection with 457 exchanges in Ohio and the reports from the various towns were telephoned to the headquarters in Cleveland.

MANSFIELD, OHIO.—Prominent business men of Mansfield who own a minority interest in the stock of the Mansfield Telephone Company are considering a proposition to buy out the interest controlled by the Federal Telephone Company of Cleveland, and thus place the entire ownership of the property in Mansfield. It is probable that the deal will go through.

CLEVELAND, OHIO.—The Federal Telephone Company has sold its interest in the Lima Telephone Company to the Ideal Construction Company, of which A. W. Hoge, of Lima, is president. The company has $100,000 of preferred stock, $150,000 common stock and $118,000 of 5 per cent. bonds. The Federal owned $40,000 par value of preferred stock and $80,000 of common stock.

MARKHAM, TEX.—The Northern Irrigation Company is constructing a private telephone company between this place and its large rice plantation.

DEPORT, TEX.—A contemplated increase from 80 to 100 subscribers is looked for by the Deport Telephone Company. The charges are $1.25 and $2 per month.

BEAUMONT, TEX.—It is announced that the Southwestern Telegraph & Telephone Company will expend about $150,000 in the erection of a new exchange building here and in putting its wires underground. New equipment will be installed.

OGDEN, UTAH.—The Rocky Mountain Bell Telephone Company has placed an order with the Western Electric Company for underground cables, which will take the place of the overhead wires.

FREDERICKSBURG, VA.—The Southern Bell Telephone Company has recently purchased the local company at Fredericksburg and a new plant will be installed. W. T. Jones has been appointed manager of the Bell Company at Fredericksburg.

COLFAX, WASH.—The Crumbaker Telephone Company has been incorporated by M. A. Crumbaker, Thomas Neill and Bert Ray. The capital stock is $10,000. The organized property was formerly conducted by Mr. Crumbaker, and the lines extend to the most thickly settled part of Whitman County.

KEYSER, W. VA.—The Piedmont & Keyser Telephone Company took up by purchase the Piedmont Telephone Company, Keyser & Petersburg Telephone Company, Keyser & Headsville lines, Mims Telephone lines, Burlington & Moorefield Telephone Company, Gordon Telephone Company, and Romney & Moorefield telephone lines. Three switchboards are operated, Stromberg-Carlson apparatus being used. The subscribers number about 300.

PARKERSBURG, W. VA.—The plant of the West Virginia Western Telephone Company has recently been rebuilt and 800 connections have been added within a year. Additional subscribers at the rate of 100 a month are asking for service. The demand for rural service is greater than the company's ability to supply. Mr. A. C. Davis, general superintendent and office manager, says that the business is increasing throughout the entire system both in extensions and new work. It is proposed to build 75 miles of toll line before long. In Parkersburg there are 1600 subscribers; outside of the city 1200 people are supplied with service. The charges are $18 and $24.

BELOIT, WIS.—The Beloit Telephone Company has at present 700 subscribers. An increase of 100 telephones during the coming year is looked for.

BRISTOL, WIS.—One hundred and fifteen subscribers are furnished with service through the Bristol Telephone Company, which operates 60 miles of toll line.

SUNNYSIDE, WIS.—The Christian Co-operative Telephone Association has 170 subscribers, and has 75 miles of toll line. Eureka and Stromberg-Carlson apparatus are used.

ALMOND, WIS.—The Almond Telephone Company, numbering 43 subscribers in the village and a total of 160 in the surrounding farming country, reports a steady increase. The company contemplates running party lines into the country.

MADISON, WIS.—The Waldwich, Jonesdale & Hollandale Farmers' Telephone Company, of Jonesdale, Iowa County, has been incorporated with a capital stock of $4000. The incorporators are Richard Jackson, William N. Uren and Peter Walsh.

DURAND, WIS.—The telephone service at this place is supplied by the Durand Light & Power Company, using a Stromberg-Carlson 160-drop switchboard and numbering 175 subscribers. The company recently built a 12-mile pole line of its own, having previously rented the poles of the Bell Company.

BLACK RIVER FALLS, WIS.—The Central Wisconsin Telephone Company, which recently added 25 miles of toll line, has the construction of 25 miles more in view. Four hundred patrons subscribe for the service. The company reports a most encouraging outlook and states that many farmers' lines are being constructed and that the local demand is greater than ever. Kellogg apparatus is used.

AMERY, WIS.—A telephone extension to Clear Lake has recently been completed by the Amery Electric Company. It is planned to install new switchboards at Amery and Clear Lake in the future. There are 47 subscribers at Clear Lake, 76 at Amery and 102 party lines. There has recently been a

slight increase in the rate charges and still the system grows. Mr. George F. Griffin is president.

ARCADIA, WIS.—The Western Wisconsin Telephone Company, using Stromberg-Carlson and American Electric apparatus, operates seven exchanges at the following places: Arcadia, 100 drops; Independence, 50 drops; Whitehall, 60 drops; Blair, 50 drops; Ettrick, 50 drops; Galesville, 100 drops; Centerville, 50 drops; Trempealeau, 50 drops. There are 500 subscribers and 400 miles of toll lines in this system. The rates charged are $12 for residence, and $25 per annum for business service.

DELEVAN, WIS.—The Walworth County Telephone Company controls the exchanges at this place and at Elkhorn, the former having 260 subscribers and the latter 108. Standard Telephone & Electric Company instruments are used in these exchanges. Mr. H. C. Hackney, the president, states that the company controls another company which is doing nothing but farm and toll line work. At least 100 farm telephones and 50 miles of toll line will be installed and built during the next six months.

WINNIPEG, MAN.—The Bell Telephone Company will probably erect a new exchange building in this city next season.

ELECTRIC LIGHT AND POWER.

JUNEAU, ALASKA.—A landslide from Mount Juneau recently wrecked a large section of the flume which conducts power water to the electric light station supplying Juneau with light. Repairs were commenced at once.

HOLTON, CAL.—Bids are wanted Jan. 1 for erecting the $75,000 electric plant of the Holton Power Company. W. F. Holt, of Redlands, is president.

SANTA CLARA, CAL.—This town has come into control of the incandescent lighting system of the United Gas & Electric Company. The contract is limited to a period of five years, and during that time the United Gas & Electric Company will refrain from supplying current for light or for stationary motors in the town. Payment is to be made by the town at the rate of 2½ cents per kw-hour for energy under 25,000 kw. Over 25,000 kw the rate is 2 cents, and 35,000 kw or more 1¾ cents.

SAN FRANCISCO, CAL.—After considerable delay while the advisability of joining the merger of San Francisco lighting companies was being discussed, the Mutual Electric Light Company is taking steps to proceed with the construction of its new electric power house on the site at the corner of Folsom and Steuart Streets. The two 1500-kw Bullock 2-phase generators for the new station are now on the way to San Francisco. Each of these 2200-volt, 60-cycle, revolving field machines will be direct connected to a Pennsylvania Iron Works Corliss horizontal engine operating at 80 r.p.m. The new plant will be thoroughly up-to-date with a salt-water supply for condensing purposes. A simple and effective conduit system will be installed for distribution throughout the underground district. The company recently arranged for a bond issue of $400,000 to provide for the new construction work.

DENVER, COL.—Chas. B. Haskell, secretary of the Routt County Electric Light & Power Company, states that bids for the work on the proposed electric light plant will be received about Jan. 1. The probable cost will be $60,000.

WATERBURY, CONN.—The question of installing an electric light plant in the city hall, to light the public buildings, is under consideration. R. A. Cairns is City Engineer.

WASHINGTON, D. C.—According to the annual report of Walter C. Allen, electrical engineer for the District of Columbia, for the fiscal year ended June 30, 1903, the work of changing the system of arc lighting from the old-style, open-series lamps to those of the enclosed type was completed during the year. The number of such lamps in operation, June 30, 1903, was 584 enclosed-multiple lamps. The service, it is stated, has been greatly improved by this change, the number of lamps reported out being considerably reduced. According to the report, 9.4 miles of underground cable, containing 282.85 miles of wire was laid during the year. The total number of miles of underground cable now laid in the District is 21.58 aggregating 1,046.20 miles of conductor.

WASHINGTON, D. C.—The Universal Light & Power Company has been incorporated here with a capital stock of $750,000. The incorporators are Robert K. Van Mater, Ralph Wormelle, Edwin L. Bradford and Leonard A. White.

SANDERSVILLE, GA.—Nisbet Wingfield, of Augusta, will prepare plans for water works and an electric light plant for Sandersville. Bonds have been sold, and bids for construction will soon be asked.

JOLIET, ILL.—It is reported that the Gaylor Syndicate is about to start work to develop water power south of Joliet on Des Plaines River and Drainage Canal. Major Siddons, of Chicago, is chief engineer.

QUINCY, ILL.—There is a lighting war on at present between the Quincy Gas and Electric Light Company and the Independent Light and Power Company. The former announces that it has cut its rates to the extent of 60 per cent.

COLUMBUS, IND.—The city council has decided to install a new electric light plant to take the place of the present one which is obsolete and worn out.

TELL CITY, IND.—The Tell City Electric Company has turned over all its property, including the electric light plant and entire system, to the city. The plant is being moved to the water works plant at the outskirts of the city The electric lights will hereafter be furnished by the city.

MARION, IND.—The Citizens' Light & Heating Company, which was recently granted a franchise in this city, has, we are informed, refused the same on account of the unreasonable restrictions imposed by the City Council. The company is not yet in existence, but will probably be organized after the election of the new council.

NEVADA, IA.—About $7000 will be expended in improvements to the electric light plant. W. A. Curtis is the manager.

HAMBURG, IA.—It is reported that John Gotsche and others propose constructing an electric light system along country roads. It will be necessary to enlarge the local light plant.

GIRARD, KAN.—W. H. Ryan, mayor, writes that it is proposed to construct a municiapl electric light plant to cost about $20,000.

HARRODS, KY.—Seasongood & Mayer have purchased an issue of $12,000 worth of bonds to insure the building of a municipal lighting plant.

WAKEFIELD, MASS.—It was voted Nov. 9 to appropriate $2600 to extend the electric light plant.

WARE, MASS.—The Ware Electric Light Company has appropriated $20,000 to be expended in enlarging its power plant.

BELZONI, MISS.—The citizens have voted to issue $20,000 bonds for water works and an electric light plant.

WHITEFIELD, N. H.—P. T. Kellogg, of Whitefield, is interested in developing the power at the plant of the Molly Falls Light & Power Company.

MILFORD, N. H.—The Milford Electric Light Company's plant was sold at auction recently and bid in by an agent of the bondholders for $53,800. The plant furnishes current for both Milford and Wilton.

JAMESTOWN, N. Y.—It was voted Nov. 3 to raise $15,000 by direct tax for enlarging the lighting plant.

SIDNEY, OHIO.—An ordinance is under consideration in Council granting H. Bailey and associates, of Piqua, a franchise for an electric light plant.

TROY, OHIO.—The contract for an electric light plant for the court house has been awarded to the Hobart Electric Mfg. Company, of Troy, for $5047.

MANSFIELD, OHIO.—D. S. Koontz, Clerk of Council, writes that the citizens have voted to grant a franchise to the Mansfield Railway, Light & Power Company.

TOLEDO, OHIO.—The Toledo Railway & Light Company is proposing to build an addition to its plant. The new equipment will include boilers, engines, generators, etc.

GENEVA, OHIO.—The Geneva Electric Illuminating Company, capital stock $1000, has been incorporated by Elmer G. Derr, Alonzo M. Snyder, F. A. Henry, H. B. Graw and others of Geneva.

COLUMBUS, OHIO.—It is stated that the Board of Service plans to construct a dam in Olentangy River at the new municipal light plant to supply the same with water independently of the present water works. The cost will be about $7000.

MT. VICTORY, OHIO.—The Mt. Victory Electric Light Company, of Hardin County, has been incorporated with $10,000 capital stock by J. J. Boone, H. E. Dickinson, W. F. Witcraft, A. L. Boyd, T. J. Boyd and J. N. Richardson.

BARBERTON, OHIO.—The village council has granted a lighting franchise to O. C. Barber, J. K. Robinson and M. J. Alexander who own the Barberton Inn. They propose to install a lighting plant and will furnish current to business houses.

CLEVELAND, OHIO.—Mayor Tom L. Johnson's cherished plan to bond the city for the purpose of erecting a municipal lighting plant to supply the city with current for lighting and to enter into direct competition with the Cleveland Electric Illuminating Company, was defeated at the election on Nov. 4.

STEELTON, PA.—The Steelton Heat, Power & Light Company is stated to have secured the contract for lighting the city for five years, at $53 per light per year.

JEANNETTE, PA.—The Jeannette Light Company has just completed the installation of 60 enclosed arc lamps in the streets of this place.

JOHNSTOWN, PA.—The Johnstown Light, Heat & Power Company and the Citizens' Light, Heat & Power Company, of this city, are to be consolidated. The new company will install some new equipment which has already been purchased. The latter includes three 400-kw turbine sets installed by Westinghouse, Church, Kerr & Company, boilers, pumps, etc.

NEWPORT NEWS, VA.—The City of Newport News is considering the advisability of establishing a city electric light plant and the city electrician has been instructed to submit estimates.

SEATTLE, WASH.—The Wagner-Bullock Electric Company, of San Francisco, Cal., has secured the contract for the generator equipment of the municipal electric light plant for $17,686.

REPUBLIC, WASH.—Extensive improvements are being made in the plant of the Republic Light & Power Company. A flume has just been completed, and the new equipment will include a revolving field, General Electric 150-kw generator.

PLAINFIELD, WIS.—The city electric light plant was inaugurated recently, the event being marked with a dinner and a general holiday.

GUANAJUATO, MEX.—The formal inauguration of the great electric light and power plant of the Guanajuato Electric Light & Power Company which took place here on Oct. 29 was made the occasion of festivities and celebrations lasting several days. The importance of the project led to the presence of President Porfirio Diaz and members of his cabinet and many other federal and state officials. The company is composed of Americans. Henry Hine, of Colorado Springs, Colo., is president; John Hays Hammond, vice-president; Leonard E. Curtis, treasurer; Irving W. Bonbright, secretary; H. H. Filley, resident manager and chief engineer; Robert F. Doble, of San Francisco, consulting engineer. The horse power already installed is 4000 while the capacity of the water head and the transmission lines is 8000-hp. The cost of the work up to this time is about $500,000, Mexican money. The construction of the plant began fourteen months ago. Details of this plant have already been printed in these columns.

THE ELECTRIC RAILWAY.

LOS ANGELES, CAL.—It is announced that the Pacific Electric Railway Company will abolish its steam power plant at Pasadena and install a substation there. The central station at Los Angeles is to furnish all power for the company's suburban lines.

HARTFORD, CONN.—At the annual meeting of the Farmington Street Railway Company in Hartford the directors elected Mr. James, president; Mr. Barney, vice-president, and Mr. Robbins, secretary, treasurer and general manager.

DANBURY, CONN.—The United Gas Improvement Company, of Philadelphia, which controls the Connecticut Railway & Lighting Company, has voted to proceed at once with the building of its trolley extension from Cheshire to Waterbury. An engineer is now engaged in buying the right of way for the extension.

LEWISTON, IDAHO.—It is said that articles of incorporation will soon be taken out for the Lewiston & Southeastern Electric Railway Company. Back of the company is Col. Judon Spofford. The plan is to build an electric railway from Lewiston to Grangeville.

CHICAGO, ILL.—Judge Grosscup decided that the receivers of the Chicago Union Traction Company shall increase the wages of the power house and shop men of the Chicago Union Traction Company 10 per cent.

DECATUR, ILL.—The street railway, gas, electric light and steam heating properties of Decatur, all owned by the McKinley syndicate, are to be consolidated with the Decatur, Springfield & St. Louis Railway, which is now under construction.

CHICAGO, ILL.—The Sanitary District of Chicago has decided to permit the South Side Elevated R.R. Company to draw water from the 39th Street conduit for use for condensing purposes in its new power house. The company is to pay the Sanitary District $1.00 per rated horse power a year as compensation. This will yield the District about $6000 a year in revenue.

GRANITE CITY, ILL.—The power house and car sheds of the Granite City & St. Louis Electric Railway Company, now located in Venice, are to be removed to Granite City. The change of location is mostly due to the fact that in the near future the line will be extended to several large cities in the county, and the location selected in Granite City is more central. The erection of the buildings will be commenced this winter.

FREEPORT, ILL.—The Freeport-Dixon Electric Company has been incorporated, capital stock $50,000. The incorporators and first board of directors are O. T. Smith, F. W. Siecke, W. A. Hance, Boyd P. Hill, C. J. Hildreth, R. P. Eckert and F. A. Reed, all of Freeport. It is proposed to construct a line from Freeport, Stevenson County, Ill., to South Freeport station, thence to Forreston and Polo, in Ogle County, and thence to Dixon, in Lee County.

CHICAGO, ILL.—Three thousand employees of the Chicago City Railway went out on strike on the morning of Nov. 12. The company made a few attempts to run cable and electric cars during the forenoon, but violence immediately began on the part of the sympathizers of the strikers. Crews of non-union men were assaulted and several were severely injured. Car windows were smashed; slots plugged and other acts of violence committed. The assurances of a peaceable strike were openly violated on every hand. The public was greatly inconvenienced and all sorts of vehicles were pressed into service for public transportation. The men struck when the company refused to increase wages from 24 to 28 cents an hour for motormen and conductors. They also demanded a "closed shop" policy, none but union men to be employed, and that their demands he submitted to arbitration. The company was willing to arbitrate the wage question, but would not agree to the "closed shop" policy. At the present writing the Wentworth Ave. electric line is being operated under the protection of 1000 policemen and the company is preparing to establish service on other lines in a like manner. There is still more or less violence on the part of the sympathizers of the strikers. General Manager McCulloch stated that no one connected with the company "is thinking about arbitration." On Monday of this week 150 lineman, repair men and dynamo men joined the strike.

COLUMBUS, IND.—An interurban electric railway to connect Columbus, Hope, Norristown and Shelbyville is projected. The line will be 26 miles in length.

VALPARAISO, IND.—The Northern Indiana Traction Company will ask Valparaiso for a franchise for the new South Bend-Chicago line. Franchises have been granted by South Bend, New Carlisle, Laporte and Westville.

JEFFERSONVILLE, IND.—The Ohio Valley Traction Company has been organized to construct an electric railway from this city to the State forest preserve near Henryville, and to erect a modern hotel at Blue Lick Springs, George H. Holzbog, E. C. Eaken and G. H. Voight are interested.

RICHMOND, IND.—Contracts have been let for enlarging the power house of the Dayton & Western Traction Company at West Alexandria, and for equipping it with additional machinery. This addition to the power facilities of the company is made necessary by the large increase in traffic.

SEYMOUR, IND.—At a recent meeting in this city of the stockholders of the Central Indiana Electric Railway Company the following directors were elected: J. T. Stout, John Stratton, J. B. Burrell, G. A. Robertson, H. C. Johnson and G. W. Caldwell. Chief Engineer Cranshaw announced that the survey of the line from Columbus to French Lick had been completed. Construction work on this line will begin early next year.

TOPEKA, KAN.—Senator J. K. Codding, of Westmoreland, and L. G. Beal, of Topeka, are interested in a plan to construct an electric railway from Topeka west along the Kaw Valley to Manhattan.

FRANKFORT, KY.—Articles of incorporation have been filed with the Secretary of State for the incorporation of the Frankfort and Versailles Traction Company; capital $300,000. The new company will operate the recently acquired Frankfort & Suburban Street Railway and extend the line to Versailles. Albert Norvali, of Cincinnati, Jno. T. Buckley, of Frankfort, and others are interested.

KEYSER, MD.—An electric railway will be built between Keyser and Westernport, Md., making a continuous line from Cumberland to Keyser.

MILFORD, MASS.—At the annual meeting of the Milford & Uxbridge Street Railway Company the following officers were elected: John T. Manson, of New Haven, president; Sydney Harwood, of Boston, vice-president; J. E. Walker, of Milford, Mass., treasurer.

TEMPLETON, MASS.—After failing to get authority from the Railroad Commission to issue a large amount of bonds, it is said that William E. Barrett, who practically owns the Templeton Street Railway Company, will put the affairs of the company into the hands of a receiver.

FLINT, MICH.—A franchise has been granted for the Flint-Flushing-Fenton electric line. E. O. Wood, of Flint; Clarence Tinker, of Fenton, and Franklin P. Sayre, of Flushing, are the promoters.

NILES, MICH.—S. G. McMichael, of Chicago, who heads a project to build an electric railway from Benton Harbor to Dowagiac via Eau Claire, has been in Niles in quest of a franchise. It is the intention to build the line from Eau Claire to Niles.

GRAND RAPIDS, MICH.—It is announced that the power house for the proposed Grand Rapids & Iona Railway will be located at Lowell. Among those interested in the enterprise are Gov. A. T. Bliss, of Saginaw; E. M. Hopkins, of Dayton; ex-Gov. J. T. Rich, of Detroit; J. L. Hudson, of Detroit; C. H. Pomeroy, of Saginaw; Robert Graham, of Saginaw.

VIRGINIA CITY, MONT.—The Bismarck-Nugget Mining Company has secured a franchise for an electric railway from Sheridan to Brandon.

RENO, NEV.—The City Council has granted a street railway franchise to J. B. O'Sullivan, John Saunderland and Oscar Smith.

TRENTON, N. J.—The Trenton Terminal Railroad Company has been incorporated in this city for the purpose of building a connecting line between the Camden & Trenton Railway and the Trenton & New Brunswick Railroad. The capital of the company is $100,000, and the road, as at present planned, will be 2900 ft. long. The incorporators are Henry V. Massey, of Merion, Pa.; Mitchell B. Perkins, of Beverly, N. J.; James S. Gilbert, of Bordentown, N. J.; R. W. D. Alboury, of Beverly, N. J.; Linton Satterthwaite, Stephen A. Cook and A. V. Robinson, of Trenton.

PORT CHESTER, N. Y.—The New York State Court of Appeals sustained the State Railroad Commission in its grant of the certificate of public convenience under Section 59 of the railroad law to the New York & Port Chester Railway Company. The case is a proceeding in certiorari brought by the New York City and Westchester Railroad against the Railroad Commission. The Port Chester road thus wins in all courts. The New York aldermen still hold aloof, however, from a favorable vote or any action at all.

AKRON, OHIO.—The Northern Ohio Traction & Light Company has placed a contract with the General Electric Company for a 700-hp Curtis turbo-generator unit, to be installed at the main power house in Akron.

PAINESVILLE, OHIO.—The Cleveland, Painesville & Eastern Railway is extending its line in Painesville to connect with the tracks of the Cleveland, Painesville & Ashtabula Railway now operating to the outskirts of the town.

TOLEDO, OHIO.—It has developed that parties independent of the Detroit, Monroe & Toledo Short Line Railway are securing a right of way for a line from Toledo to Detroit. The proposed route taps territory to the west of the present line.

MARIETTA, OHIO.—The Parkersburg, Marietta & Interurban Railway is making surveys for a line from a point opposite Marietta to Sistersville, on the West Virginia side, a distance of 35 miles. Eventually this will be extended to Wheeling, forming an unbroken line of electric roads from Parkersburg to Pittsburg.

CONNEAUT, OHIO.—The Conneaut & Erie Traction Company has completed its line, and the first car was run from Erie to Conneaut a few days ago. There is now an unbroken line of electric roads from Erie to Toledo, and links which will complete communication between Buffalo and Chicago are under actual construction.

CINCINNATI, OHIO.—The Cincinnati Rapid Transit Railroad Company has elected the following officials: J. G. Schmidlapp, August Herrmann, H. H. Hoffman, W. H. Alms, M. E. Ingalls, C. H. Rowe and L. Ault, directors. J. G. Schmidlapp was elected president; August Herrmann, vice-president, and H. H. Hoffman, secretary. The company will shortly place $250,000 stock on the market.

LAWTON, O. T.—The Lawton, Wichita Mountain and Western Electric Railway Company has been organized for the purpose of building an interurban electric railway 75 miles long to run from Lawton to Fort Sill and from Lawton to Lone Wolf. The company has its principal office at Lawton. Its capital stock is $200,000. The financial arrangements for building the road are said to have been made. Among the incorporators are C. W. Johnson, of Montgomery, Ala.; S. P. Brundage, of St. Louis, Mo.; J. R. Brattan, of Carthage, Mo.; Edward F. Mitchell, of El Reno, Okla.

SUMPTER, ORE.—From present indications the construction of an electric road between Sumpter and Bourne, Ore., will be under way within the next few months. Henry Hewett, a wealthy lumberman of Tacoma, has agreed to furnish 75 per cent. of the capital. The cost of constructing the road is estimated at from $75,000 to $100,000.

CHAMBERSBURG, PA.—The Chambersburg, St. Thomas & Fort Loudon Electric Railway Company has been organized to build an electric railway from Chambersburg to St. Thomas and Fort Loudon. The officers of the company are John R. Eberly, president; Frisby Miller, secretary; Dr. F. G. Strock, treasurer.

BANGOR, PA.—The Bangor, East Bangor & Portland Street Railway Company has purchased the large plant of the Bangor Electric Light, Heat

& Power Company. The trolley company intends making some alterations, after which it will extend the line from the present terminus at Portland to the Delaware Water Gap and Stroudsburg.

WEST CHESTER, PA.—The West Chester & Pottstown Improvement Company, recently incorporated, has organized as follows: Bayard A. Conrad, of Font, president; Frank Green, of East Goshen, vice-president; Horace A. Felters, of Upper Mochlan, secretary. The plan of the company is to build an electric railway through Oaklands, Whitford, Lionville, Eagle, Font, Ludwig's Corner, Nantmeal Village and Pughtown.

ALTOONA, PA.—The Altoona City Passenger Railway Company, the Tyrone Electric Railway Company, and the Altoona & Logan Valley Electric Railway Company have been recently consolidated under the name of the Altoona & Logan Valley Electric Railway Company. This property is one of the more important properties owned by The American Railways Company, which, four years since, acquired practically all of the stock of the Altoona & Logan Valley Electric Railway Company, and through the said company most of the stock of the Altoona City Passenger Railway Company. All of the remaining shares of these companies have since been purchased by The American Railways Company, which has also taken over the stock and bonds of the Tyrone Electric Railway Company.

NASHVILLE, TENN.—F. P. Pond, local solicitor of the Interurban Electric Railway, has been notified that a deal has been closed, which assures the building of the interurban roads to Gallatin and Mt. Pleasant. C. W. Ruth, of Pittsburg, is president of the company.

MEMPHIS, TENN.—The Westinghouse Electric & Manufacturing Company is preparing plans and specifications for the 25-mile electric railway to be built between Memphis and Colliersville, Tenn. The line will cost, it is said, $100,000 and is being projected by the Shelby Traction Company.

DENISON, TEX.—The capital stock of the Denison & Sherman Railway Company has been increased from $100,000 to $200,000. It is stated that the company will make extensive improvements.

EL PASO, TEX.—J. H. Nations, J. S. Dodge and others of this city have applied to the city council for a franchise for the construction and operation of a street railway to run to the Highland Park addition.

TAYLOR, TEX.—Henry Wisden, of Columbus, Ohio, has been investigating the situation with the view of building and operating an interurban electric railway between this place and Austin. It is reported that the project contemplates the establishment of a large power plant on the Colorado River.

WHEELING, W. VA.—The Wheeling Traction Company may extend its line from Barton to St. Clairsville.

FOND DU LAC, WIS.—The Wisconsin Central Railway Company has filed an amendment to its articles of organization providing for the building of two extensions, one from Park Falls, Price County, 10 miles northeast into Ashland County; the other, from Glidden, Ashland County, 8 miles southwest.

MONTREAL, QUE.—The Montreal Terminal Company has applied to the City Council to construct lines on a large number of the city streets.

GUELPH, ONT.—The by-law voted on recently by the citizens of Guelph for taking over the Guelph Radial Railway by the city was carried. The cost will be $78,000.

PORT ARTHUR, ONT.—Port Arthur is about to increase its electric power for running its municipal lighting plant and the street railway between Port Arthur and Fort William. The additional power will be secured from the Current River.

LEGAL.

TELEPHONE RIGHT OF WAY.—A Supreme Court decision at Topeka, Kan., requiring telephone companies to secure rights of way from owners of land along public highways will cause much vexation to telephone companies in Kansas. Telephone lines are being built all over the state, and thousand of instruments have been placed in farmers' houses. Now these companies will have to secure rights of way and pay concessions to many farmers.

NEW INDUSTRIAL COMPANIES.

THE THOMPSON ELECTRIC COMPANY, of St. Paul, Minn., has changed its name to Northwestern Electrical Supply Company.

WILLIAMS ELECTRIC & MANUFACTURING COMPANY, of Jersey City, has been incorporated; capital, $10,000. Incorporators: J. Edgar Tackaberry, James T. Clark and George A. Williams.

MARCELLUS & WALTON, New York, have been incorporated to manufacture motors and electrical machinery; capital, $10,000. Directors: H. L. Marcellus and F. W. Walton, New York, and H. L. Hull, Brooklyn.

THE MOLINE INCANDESCENT LAMP COMPANY, of Moline, Ill., has been incorporated to manufacture electrical apparatus; capital, $30,000. Incorporators: Albert H. Kreitler, Conrad F. Gratz, Sr., Elmer E. Morgan.

BROWN ELECTRICAL CONSTRUCTION COMPANY, Chicago, has been formed with a capital of $50,000, for manufacturing electrical and mechanical supplies. Incorporators: William E. Church, Roger Sherman, David O. Dundar.

THE GENERAL STORAGE BATTERY COMPANY, of New York City, has been incorporated with a capital of $1,000,000 to manufacture electric storage and primary batteries. The directors are Julius H. Susmann, John G. Greenburgh, Adolph Prochownick and Joseph Rijur, of New York City.

THE AMERICAN AUTOMATIC SWITCH COMPANY has been incorporated at Pueblo, Col., with a capital stock of $100,000, to manufacture a patented automatic street car switch. T. G. McCarthy is president; W. K. Smith, secretary and general manager, and George H. Williams, treasurer.

THE BALDWIN-ROWLAND ELECTRIC SWITCH COMPANY has been incorporated at New Haven, Conn., to manufacture a street railway switch. The company is capitalized at $125,000. The officers are: President, R. S. Woodruff; vice-president, H. L. Rowland; treasurer, N. W. Kendall; secretary and general manager, F. W. Raymond.

PERSONAL.

MR. RALPH D. MERSHON, E. E., has returned from a trip to England and the Continent made for consultation work.

MR. JOHN M. ANDERSON, treasurer of the Albert & J. M. Anderson Manufacturing Company, of Boston, Mass., was a visitor in New York last week.

MR. A. FREDERICK COLLINS has taken space in the Electricity Building at the St. Louis Fair, to exhibit his apparatus for wireless telephony, etc., which has aroused a good deal of public interest.

MR. R. PERCY SELLON, E. E., who is prominently identified with electrical affairs in England and is connected with the Otis Elevator interests there, is visiting this country for a few weeks. Mr. Sellon was last over here in the Spring of 1902.

MR. W. KELSEY SCHOEPF, president of the Cincinnati Traction Company, confirms the story that the Elkins-Widener Syndicate will spend $10,000,000 developing 200,000 horse power on the Ohio Falls, and supply current to Indianapolis and Cincinnati traction lines.

DR. F. A. C. PERRINE, president of the Stanley Electric Manufacturing Company, and formerly professor of electrical engineering at Leland Stanford, Jr., University, will deliver the Founder's Day address, Nov. 30, at the Thomas S. Clarkson Memorial School of Technology, Potsdam, N. Y.

MR. CHARLES T. YERKES arrived from London last week. As to work in the British metropolis he said: "We have enough money and are satisfied to carry out what we have started. The work in London on the new electric underground is well under way, and about one-half of it, the part from Baker Street to Waterloo, will be finished in about one year. The rest will be completed within five years."

MR. FRANK MARTIN, who for some three years past has held a position under the U. S. Navy Department, in charge of the light, heat and power plant at the Brooklyn Navy Yard, has resigned in order to assume charge of the electrical department of the University Power Company, Princeton, N. J., which will furnish light, heat and power to Princeton University, campus, etc., and in the town. The plant is just about starting up.

MR. W. D'A. RYAN.—At the 238th meeting of the New York Electrical Society, which will be held Nov. 30, in this city, Mr. W. D'A. Ryan will lecture on "Practical Problems in Lighting and Illumination." This lecture will be full of interest, and will be illustrated by numerous experiments. Mr. Ryan has long given special attention to the engineering aspects of illumination, and his lecture will have a decidedly practical value.

MR. FREDERIC J. NICHOLLS, the well-known Canadian electrical manufacturer and general manager of the Canada Foundry Company and Canadian General Electric and Dominion Iron, states that he considers that the present depression in the iron and steel markets is purely temporary, and that better prices will be seen in the near future. In expectation of better prices Mr. Nicholls has advised the Dominion Iron & Steel Company to proceed with the erection of new mills.

MR. ARTHUR W. FIELD has retired from the position of secretary and general manager of the Edison Electric Light Company of Columbus. His retirement is the result of the merger of the Edison Company with the Columbus Railway Company, the new company being a leasing company known as the Columbus Railway & Light Company. Mr. Field has been identified with the Edison interests for a number of years. He was one of the organizers of the Ohio Electric Association and was twice president of that organization.

MR. J. B. HOGE, secretary of the Federal Telephone Company, Cleveland, Ohio, has been made general manager of the entire Federal properties and will succeed Mr. Maxime Reber who will enter business in St. Louis. Mr. C. Y. McVey, at present manager at Youngstown, will become assistant general manager of the Federal Company. Mr. W. F. Crossley, superintendent of the Columbiana County system, will also have charge of the Youngstown system. Mr. O. F. French, for some time acting manager of the Cuyahoga Telephone Company has been made general manager of that company.

DR. W. J. MORTON writes us to say that the newspaper reports of his remarks before the Society of Medical Jurisprudence are not quite correct, as noted in our issue of November 14. "As to what kind of cancer could be cured or could not be cured, I didn't draw the distinction as it appears, and as to the remark that 'I have a patient whom I have been trying to burn for a year and he simply won't burn,' this was made by another speaker, and is so utterly at variance with the physical facts, that it would be most painful to me to father it."

MR. C. H. HINES.—Official announcement is made of the appointment of Mr. C. H. Hines as electrical engineer of the Canadian Pacific Railway, with headquarters at Montreal. He reports to Mr. E. A. Williams, the superintendent of rolling stock. His duties are thus defined: He will have general supervision over all electrical matters, including power and lighting circuits, generators, motors, arc and incandescent lamps, and other electric machinery and apparatus as directed. He will prepare standard and special plans and estimates as required, and it shall be his duty to supervise the construction, operation and maintenance of electric installations and circuits in order to insure compliance with plans, rules and specifications pertaining to same. In the execution of new work, general and special repairs and maintenance of electric plants, divisional employees will act under his instructions as directed and limited by the general superintendents of their respective divisions.

MR. JOHN CALDER, who has been with the C. W. Hunt Company as its executive engineer, left on Nov. 14, for Ilion, N. Y., where he will be connected with the management of the Remington Typewriter Company. Before leaving, he was treated to a pleasant surprise. A few minutes before the noon hour, members and employees of the company gathered around his desk to participate in the presentation of a handsome silver loving cup suitably inscribed. Mr. George S. Humphrey presented the token to him, with a few appropriate remarks, expressing the esteem in which he was held both professionally and personally by the donors. Mr. Calder made a brief impromptu reply, expressing his thanks for the gift and his regret at severing the pleasant associations he had formed while in the employ of the C. W. Hunt Company. While this company loses an efficient officer, the Remington Typewriter Company is to be congratulated on the acquisition of a man of Mr. Calder's ability and standing.

MR. ARTHUR A. HAMERSCHLAG has been nominated by the trustees of the Carnegie Institute as president of the Carnegie Technical Schools of Pittsburg. The salary is $8000 a year. He was born in Nebraska, 36 years ago, graduated from the Hebrew Technical Institute, New York, in 1889, taking afterwards special courses in physics and mining at Columbia University. Mr. Hamerschlag was for twelve years superintendent of St. George's Evening Trade School and for eight years consulting engineer, lecturer and organizer for the New York Trade School. He is consulting engineer for Highland Falls Trade School at Highland Falls, N. Y.; Boys' Preparatory Trade School, New York City; Manual Training School of the Church of the Good Shepherd; Philips Memorial Industrial School, New York; Home Garden School, New York; Industrial School of Lynhurst, Tarrytown; McAlpin Trade School, New York, and about half a dozen other similar institutions. He is a member of the National Educational Association, the Society for the Promotion of Engineering Education, the New York Association for Organized Work Among Boys, the American Institute of Electrical Engineers, the New York Electrical Society, and he has written several papers on trade and technical education and text-books and courses of instruction for his schools.

Trade Notes.

THE MERWARTH METALLIC GASKET COMPANY has removed from 120 Liberty Street, New York, to 32 Broadway, where it has larger quarters which will give it more room for handling its increasing business.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is selling agents for Packard lamps and transformers. It is sending out advertising matter telling of the new "Salus" compound with which the Packard transformer is insulated.

MORRIS ARC LAMP COMPANY.—The trustee in bankruptcy announces that patent No. 569,881 for an electric arc lamp, which was owned by the Morris Arc Lamp Company, will be sold at the office of A. B. Geary, Chester, Pa., on Nov. 19.

MR. JACOB CLOOS, of Milwaukee, will represent the Downward Light Electric Company in that city. He will carry a full stock of the well-known incandescent lamps made by this company. The Milwaukee headquarters will be in the Matthews Building.

NATIONAL WIRE CORPORATION, New Haven, Conn., has issued under date of Nov. 1, a new telephone and telegraph wire price list, which combines the latest figures for this class of wire and the latest trade prices. Copies can be had on application by any one interested.

MARCELLUS & WALTON, the continuation of an old concern, has been formed at 16 Dutch Street, New York, with a capital stock of $10,000. Mr. H. L. Marcellus is president and Mr. F. W. Walton is secretary and treasurer. They will build electric motors of 2 to 5-hp, etc and make installations.

THE H. O. S. ENGINEERING COMPANY, 88 Warren Street, New York, recently issued Bulletin No. 40, devoted to the illustration and description of its spool handle baby knife switches in full detail. Bulletin No. 39 in similar manner deals with its "all copper panel board." There is a good demand for both of these lines of Swoboda specialties.

CROCKER WHEELER COMPANY, of Ampere, N. J., has issued in Bulletin No. 3, for October, an interesting account of a plant for lighting and motors installed by it in the Orange Brewery, with a capacity of 80,000 barrels a year. There is a 60-kw Crocker-Wheeler generator, and in addition to the lights the plant includes 13 motors of a total of 123-hp.

THE ENORMOUS STEAMING CAPACITY required in boilers on the large ocean steamships can only be attained by means of artificial draft. The fan blower may be found in all these steamships supplying air to the boilers as "forced draft." The International Navigation Company's steamship *St. Louis* has eight new Sturtevant fans for this purpose, each one of which is driven by a Sturtevant compound engine.

A CENTRIFUGAL PUMP of novel design and unprecedented capabilities will be exhibited at the St. Louis Exposition by Henry R. Worthington, of New York City. That this pump marks a distinct departure from the usual centrifugal practice will be appreciated when it is stated that it will be capable of delivering about 500 gallons of water per minute against a head of 250 lbs. per square inch, and with high efficiency. This pump is of the type known as the multi-stage, turbine centrifugal, and differs in a great many respects from the centrifugal pumps with which engineers have been familiar.

STURTEVANT SOUVENIR.—An interesting and instructive souvenir was presented to the members of the New England Foundrymen's Association on the occasion of their recent visit to the new foundry and pattern departments of the B. F. Sturtevant Company, at Hyde Park, Mass. This has been republished as Bulletin 54, a sixteen-page pamphlet, describing and illustrating these departments and particularly their industrial equipments. The removal of the foundry and pattern departments is the first step towards the removal of the entire plant from Jamaica Plain, Mass., to the extensive new works at Hyde Park, to which general attention has been recently called.

BALL CORLISS ENGINE.—The success of the new medium speed Corliss engine recently brought out by the Ball Engine Company, Erie, Pa., has been so great that it was found necessary to greatly increase the capacity of its works. Entirely new works were determined upon and an ideal location was selected. These works have been under construction during the past year, and the company has just moved into them. Although this was a large undertaking, it was accomplished without accident or any appreciable interruption of product. The new works are among the most modern in the country, well lighted and finely equipped, giving the Ball Engine Company unsurpassed facilities and a very large capacity.

HIGH GRADE TURBINES.—The Trump Manufacturing Company, of Springfield, Ohio, has issued a very handsome oblong pamphlet with regard to its water turbine, illustrating and describing a large number of the plants which it has installed, as well as showing details of the apparatus. The catalogue includes a number of foreign plants and the text is printed in English, Italian and Spanish. The Trump turbines are now to be found all over the world, being an excellent illustration of the manner in which American apparatus of high standard is patronized in various countries strictly on its merits. The catalogue is one of the most interesting and handsome that we have seen in some time.

SMITH & HEMENWAY COMPANY, of 296 Broadway, N. Y., has added to its line of hardware specialties catalogued in its well-known Green Book, the Bay State taps and dies, the entire marketing of which the above company controls. These tools are made of the finest steel procurable—are nicely finished—of excellent wearing quality and superior workmanship—especial attention having been paid to the pitch of the thread, which is absolutely correct. The U. S. V. or Whitworth thread will be made on any style tap or die. Each and every tap and die is sold under rigid guarantee, and should any defective tool be found, it will be exchanged for a perfect one. The Smith & Hemenway Company has the entire marketing of the products of the following companies: Utica Drop Forge & Tool Company, mfr. of nippers and pliers; Acme Ball Bearing Caster Company, mfr. of casters and jacks; Bay State Tap & Die Company, mfr. of taps and dies; Vandegrift Mfg. Company, mfr. of wrenches; Page-Storm Company, mfr. of drop forges; Champion Mfg. Company, mfr. of hammers, hatchets and ice picks.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOVEMBER 10, 1903.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

743,410. ELECTRODE AND CONDUCTOR; Charles Ernest Acker, Niagara Falls, N. Y. App. filed June 5, 1902. (See page 841.)

743,417. REVERSE-CURRENT INDICATOR; Leonard Andrews, Hastings, England. App. filed March 30, 1903. (See Current News and Notes.)

743,421. TELEPHONE SYSTEM; Garrison Babcock, Chicago, Ill. App. filed April 27, 1903. (See page 843.)

743,423. SYSTEM OF MOTOR CONTROL; Thomas E. Barnum, Milwaukee, Wis. App. filed March 31, 1902. Wherein a large motor and a small motor are arranged to drive a printing press or similar machine, a controlling resistance is provided having a movable element adapted at first to include all of the resistance with the small motor and afterwards to exclude all of the resistance and the small motor and include the large motor. The invention also includes switches and devices for preventing the operation of the same after the motor circuits are opened until the rheostat arm is returned to its initial position.

743,426. SYSTEM FOR OPERATING ELECTRIC ELEVATORS; William Baxter, Jr., Jersey City, N. Y. App. filed Jan. 17, 1899. A motor having sectional field coil, a manually operated controller for regulating the speed of the motor by cutting in and out the sections of the field coil and an automatically operating switch also cutting in and out the sections of the field coil.

743,431. METHOD OF CONVERTING OXYGEN INTO OZONE; Frederick S. Blackmarr and Joseph L. Willford, Minneapolis, Minn. App. filed April 26, 1902. (See page 841.)

743,432. APPARATUS FOR CONVERTING OXYGEN INTO OZONE; Frederick S. Blackmarr and Joseph L. Willford, Minneapolis, Minn. App. filed April 26, 1902. (See page 841.)

743,433. APPARATUS FOR CONVERTING OXYGEN INTO OZONE; Frederick S. Blackmarr and Joseph L. Willford, Minneapolis, Minn. App. filed October 27, 1902. (See page 841.)

743,435. APPARATUS FOR CONTROLLING TROLLEY POLES; Judson L. Bogue and David M. Jennings, Denison, Tex. App. filed May 2, 1903. Means for automatically throwing the trolley pole into position to engage the wire after it has accidentally left it, said means not interfering with the manipulation of the pole, through the cord, by the motorman.

743,441. ELECTRIC TERMINAL; Howard Brooks, Wheaton, Ill. App. filed June 20, 1902. A thimble intended to insure perfect insulation and sealing of the end of a main cable or conductor.

743,444. MEANS FOR REGULATING SELF INDUCTANCE IN ELECTRIC CIRCUITS; Charles F. Burgess, Madison, Wis., and Budd Frankenfield, Pittsburg, Pa. App. filed Jan. 27, 1903. As a means for regulating self-inductance in electric circuits, a core of magnetic material and two independent electric circuits in magnetic inductive relation to the core and in non-inductive relation to each other, the current in one circuit being varied at will.

743,457. TELEPHONE-EXCHANGE SYSTEM; George L. Cragg, Chicago, Ill. App. filed May 9, 1902. (See page 844.)

743,458. COMPENSATING SYSTEM; Elmer E. F. Creighton, Pittsfield, Mass. App. filed Dec. 29, 1902. (See Current News and Notes.)

743,459. COMPENSATING SYSTEM; Elmer E. F. Creighton, Pittsfield, Mass. App. filed Jan. 31, 1903. (See Current News and Notes.)

743,463. CONTROLLER FOR ELECTRIC MOTORS; Henry H. Cutler, Milwaukee, Wis. App. filed Dec. 30, 1901. The speed of the armature controls the continuity of a shunt circuit around the armature.

743,471. FUSE CASING AND SWITCH; Louis W. Downes, Providence, R. I. App. filed Jan. 12, 1903. The casing has a number of covers to each of which an inclosed fuse is attached, the fuse being carried into the clips by the closing of the cover.

743,493. ALARM SIGNAL FOR ELEVATORS; Edward L. Hail and George Hail, Providence, R. I. App. filed May 1, 1902. An alarm is sounded as the elevator moves along to give notice that it is in motion.

743,512. APPARATUS FOR TRANSMITTING ELECTRICAL COMMUNICATIONS; Charles M. Jacobs, Maidenhead, and Arthur H. Nicholson, Wendover, England. App. filed Aug. 2, 1902. (See page 844.)

743,514. MAGNETIC CLUTCH; Camaille Jenatzy, Fils, Brussels, Belgium. App. filed June 27, 1903. A magnetic fly-wheel having a friction surface composed of anti-friction metal and steel for preventing gripping of the plate during sliding action.

743,521. TROLLEY STAND; Frederick Kennington and David L. Fawcett, Leeds, England. App. filed Jan. 14, 1903. The pole is mounted to swing on horizontal and vertical pivots, a spring being interposed between a lug on the pole and the vertical socket.

743,522. COATING GLASS OR FABRICS; Henry Keppler, Brooklyn, N. Y. App. filed Feb. 21, 1903. (See Current News and Notes.)

743,532. TELEPHONE-EXCHANGE; John C. Fred Malthauer, Minneapolis, Minn. App. filed June 23, 1902. (See page 844.)

743,534. ELECTROTHERMAL DIFFUSER; Frederic de Mare, Brussels, Belgium. App. filed June 27, 1902. (See page 842.)

743,540. ELECTRIC CUT OUT; Louis W. Miller, Rochester, N. Y. App. filed Feb. 26, 1903. Details.

743,542. TROLLEY SIGNAL; Charles H. Morse, Cambridge, Mass. App. filed June 25, 1901. Safety and danger signals at each end of the block are controlled by electro-magnets through which current is directed by the passing cars.

743,555. SNAP SWITCH OPERATING MECHANISM; Charles G. Perkins, Hartford, Conn. App. filed Aug. 1, 1903. Details.

743,564. AUTOMATIC TELEPHONE-EXCHANGE; Malcolm C. Rorty, Dedham, and Albert M. Bullard, Somerville, Mass. App. filed Aug. 9, 1900. (See page 844.)

743,589. TELEPHONE RELAY OR STEP-UP; Gustavus E. Sundquist, Cleveland, Ohio. App. filed May 14, 1902. (See page 844.)

743,594. TELEPHONE CIRCUITS AND APPARATUS; George K. Thompson, Newton, Mass. App. filed March 31, 1903. (See page 843.)

743,598. ELECTRIC BATTERY; Edmund Tweedy, New York, N. Y. App. filed Dec. 31, 1902. (See page 842.)

743,600. ELECTRIC FIRE ALARM; Johannes W. H. Uytenbogaart, Utrecht, Netherlands. App. filed May 6, 1903. When the glass front of the instrument is broken, a pendulum contact is released and automatically makes and breaks contact with the alarm terminals until it ceases to swing; the size of the pendulum being varied for different instruments to give alarms of different periods.

743,601. MEANS FOR CONTROLLING THE SPEED OF ELECTRIC MOTORS; Arthur P. Warner, Chicago, Ill. App. filed March 20, 1903. A plurality of electric motors mechanically connected to rotate at the same relative speed, the armatures of the motors being connected in series and the fields in parallel with the source of current and means for controlling the field strength of all of the motors independently of each other.

743,603. ELECTRICAL VIBRATORY MOTOR; Charles S. Whitney, Springfield, Ill. App. filed Feb. 25, 1903. A massaging vibrator operating by alternating currents.

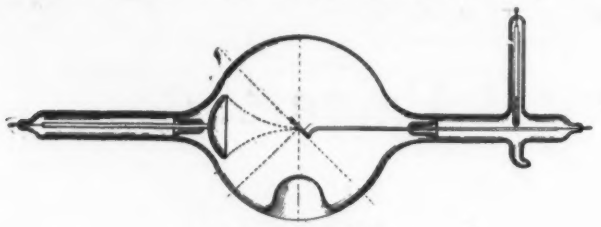
743,607. RESISTANCE FOR ELECTRIC CIRCUITS; Gilbert Wright, Pittsfield, Mass. App. filed July 15, 1902. A series of cast grids arranged in radial planes and held in position by lugs cast at intermediate points on the grids engaging with a ring frame.

743,654. ELECTRIC CAR HEATER; James F. McElroy, Albany, N. Y. App. filed Sept. 2, 1903. The heater in the motorman's compartment is automatically thrown into and out of circuit by the movement of the door of the compartment.

743,668. EXTRACTING CHROMIUM FROM CHROME-IRON ORE; Robert Suchy and Heinrich Specketer, Griesheim-on-the-Main, Germany. App. filed Feb. 6, 1903. (See page 841.)

743,718. X-RAY TUBE; John O. Heinze, Jr., Lowell, Mass. App. filed July 9, 1903. The tube has a dome shaped re-entering portion of its radiating walls projecting into the field of bombardment of the anode, the thickness of the dome portion being thinner than the radiating wall.

743,724. ELECTRIC LIGHTER; Conrad Hubert, New York, N. Y. App. filed March 17, 1903. Details of a cigar lighter.



743,718.—X-Ray Tube.

743,779. PROCESS OF WINDING ELECTRICAL COILS; Richard Varley, Providence, R. I. App. filed May 15, 1903. The layers of wire are alternated with sheets of paper the edges of which project at each end and have reinforcing strips pasted thereto to retain the end turns of the wire in place.

743,789. RAILWAY STATION SIGNAL; John L. Wrenn, Washington, D. C. App. filed June 30, 1903. A prospective passenger can turn on a signal light to stop the car, the light being afterwards turned off by the car itself.

743,805. CABLE HOLDER FOR MANHOLES; Hugh C. Baker, Jr., New York, N. Y. App. filed April 20, 1903. An upright rod fixed in the wall of the manhole carries a vertically adjustable clamp for the cable.

743,836. ELECTRIC PUMP; Otto G. Dobert, New York, N. Y. App. filed July 17, 1903. An electric motor having a rocking armature drives the piston of the pump and at the same time reverses its own connections.

743,852. BLOCK SIGNAL SYSTEM; Israel H. Francisco, Rutland, Vt. App. filed May 20, 1902. Details.

743,878. ELECTRIC BLOCK SIGNAL; William S. Jackson, Hoboken, N. J. App. filed March 5, 1903. A shoe moved transversely to the semaphore by an electro-magnet, raises the semaphore, the withdrawal of the shoe permitting it to fall by gravity.

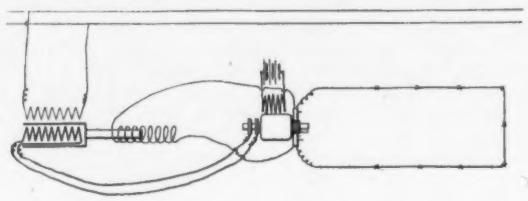
743,882. PROCESS OF MANUFACTURING PLATES OF INSULATING SUBSTANCES; Johanne Justus, Berlin-Halensee, Germany. App. filed March 9, 1903. An insulating substance is pressed into bars which are laid upon a foundation of wire network to which they are caused to adhere.

743,887. APPARATUS FOR REGULATING THE FLOW OF CURRENT IN ELECTRIC CIRCUITS; Isidor Kitsee, Philadelphia, Pa. App. filed March 1, 1901. An electro-magnetic device is connected in a shunt to the consuming circuit and adapted to move to and fro a metallic conductor placed between the primary and secondary of a converter.

743,888. ELECTRIC SAFETY APPLIANCE; Louis Klentschi, Richmond Hill, N. Y. App. filed Feb. 20, 1903. A cover for the third rail is raised and lowered by the flange of a car wheel operating upon a suitable leverage system.

743,893. HAIR SINGER; Conrad F. Lancaster, East Liverpool, Ohio. App. filed Oct. 20, 1902. The teeth which pass through the hair are electrically heated.

743,896. SANITARY ATTACHMENT FOR SOUND RECEIVERS OR TRANSMITTERS; Abraham Levi, Baltimore, Md. App. filed July 23, 1903. (See page 844.)



743,887.—Apparatus for Regulating the Flow of Current in Electric Circuits.

743,906. INCANDESCENT LAMP SOCKET; Henry E. Meyers, Denver, Col. App. filed Feb. 13, 1903. Details.

743,925. INSULATING DRAW BAR ON DRAFT LINK FOR RAILWAY TRAINS; Henry E. Procunier, Oakpark, Ill. App. filed Sept. 22, 1902. The link is made in two parts connected by an insulated joint.

743,939. SAFETY ALARM DEVICE FOR MARINE VESSELS; Marshall Shepard, Edgartown, Mass. App. filed Dec. 9, 1902. An arm trailing from the bottom of the boat operates a circuit controller when it strikes bottom.

743,941. DISTRICT MESSENGER BOX; Aaron V. Siler and Justain H. Riley, Newark, Ohio. App. filed Sept. 8, 1902. Details.

743,948. PRINTING TELEGRAPH; Walter S. Steljes, London, Eng. App. filed May 12, 1903. A device for moving along its spindle and for holding in its required printing position, a type wheel having two or more rows of letters.

743,951. TELEPHONE-TRANSMITTER; Alfred Stromberg, Chicago, Ill. App. filed Nov. 17, 1902. (See page 843.)

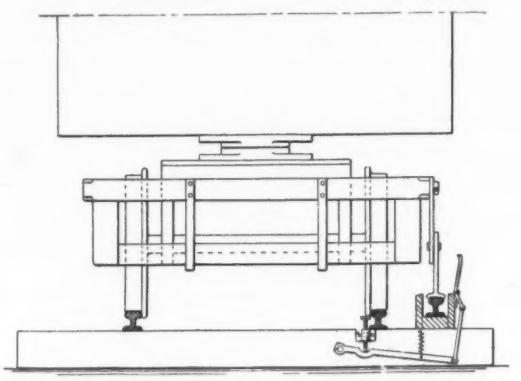
743,953. CENTRAL-ENERGY TELEPHONE SYSTEM; William A. Taylor, Chicago, Ill. App. filed Feb. 4, 1901. (See page 844.)

743,958. DYNAMOMETER FOR ELECTRIC CURRENT; Mathias E. Turner, Cleveland, Ohio. App. filed June 18, 1903. The instrument shows the maximum current used during any interval of time and is constructed not to be sensitive to temporary fluctuations.

743,970. ELECTRIC SWITCH; Christian F. Ziegler, Chicago, Ill. App. filed April 9, 1902. Details of construction of a drum having segments thereon adapted to move pivoted arms into contact with circuit terminals.

743,975. SIGNAL APPARATUS; Clyde J. Coleman, New York, N. Y. App. filed July 8, 1901. (See Current News and Notes.)

743,991. ELECTRIC FIXTURE; Kent Shaffer, Evanston, Ill. App. filed July 12, 1902. A group of sockets provided with two terminals common to all of the sockets and a plug substantially fixed with respect to the socket, the same terminals being common to the plug terminals also.



743,888.—Electric Safety Appliance.

743,999. SYSTEM OF ELECTRIC COMMUNICATION; James T. Armstrong and Axel Orling, London, England. App. filed Feb. 5, 1902.

744,000. SYSTEM OF ELECTRIC COMMUNICATION; James Tarbottom Armstrong and Axel Orling, London, England. App. filed Feb. 5, 1902.

744,001. SYSTEM OF TELEPHONIC COMMUNICATION; James Tarbottom Armstrong and Axel Orling, London, England. App. filed Feb. 5, 1902.

744,012. ARMATURE COIL; Charles Knape, Pittsburg, Pa. App. filed July 9, 1903. The invention consists in flattening and widening the opposite sides of the portion of the strap which form the coil that extends beyond the ends of the armature core, thereby giving a more compact construction.

12,168. WIRELESS TELEGRAPHY; Reginald A. Fessenden, Washington, D. C. App. filed Aug. 12, 1902. (See page 842.)

12,169. WIRELESS TELEGRAPHY; Reginald A. Fessenden, Washington, D. C. App. filed Aug. 12, 1902. (See page 842.)